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MANAGEMENT CONSULTING & RESEARCH, INC.

TR-8711/12-1

AIRCRAFT AVIONICS AND MISSILE SYSTEM
INSTALLATION COST STUDY

FINAL REPORT

VOLUME 1

TECHNICAL REPORT AND APPENDICES A THROUGH E

By:

Kirsten M. Pehrsson
George R. Kreisel

12 February 1988

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1213 Jefferson Davis Highway
Arlington, VA 22202

Contract Number: N00600-84-D-4171/0012

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This report documents a parametric cost model for aircraft avioni installations and modifications. Cost and technical data collect during a previous avionics installation cost study, as well as da collected from data sources identified during this effort were used analyze costs of individual avionics black-box modifications installations into aircraft. The report details the methodology used construct the data base and to develop cost-estimating relationshi (CERs). Details of CERs developed for non-recurring costs, recurri installation/modification kit costs, labor costs, and manhours a provided, as well as the supporting data used in the analyses. T report is only available to authorized U.S. Government personnel.

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PREFACE

Management Consulting & Research, Inc. (MCR) is providing support to the Naval Center for Cost Analysis (NCA) to develop an Avionics and Missile System Installation Cost Data Base and Parametric Cost Model. This project is being performed under contract N00600-84-D-4171 Delivery Order 0012 of 13 April 1987. This work is in essence an extension of analysis performed previously for NCA, under contract N0014-85-C-0802 of 1 September 1985, "A Parametric Aircraft Avionics and Missile System Installation Cost Model."

The Contract Data Requirements List (CDRL) calls for a technical report that documents the statistical model and results of analyses. This technical report, and separately bound data base, fulfill this requirement.

MCR is grateful to several people who assisted in obtaining and accessing the data required for both the current and previous efforts. The time and effort spent to help in the data collection effort was well appreciated. We would particularly like to thank the following people for their assistance during this most recent effort:

- Mr. Jack Moore (and others) of the Naval Air Systems Command (NAVAIR 102) who provided assistance in obtaining CCB documents and explaining the modification funding process, and
- Mr. Dan Alton, Mr. Dalton Wood, and Ms. Donna Hall of the Naval Air Maintenance Organization (NAMO), Patuxent River, for their help in accessing TDSA data and explaining the modification tracking process.

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LIST OF EXHIBITS

I. INTRODUCTION

This introduction is intended to orient the reader concerning the:

- background,
- purpose/scope of the study, and the
- organization of the report.

The following discussion assumes the reader has some familiarity with the Naval aircraft modification process. Appendix E provides a detailed description of the Navy aircraft modification funding and implementation cycle for readers who may require assistance.

A. BACKGROUND

The Naval Center for Cost Analysis (NCA) is responsible to the Secretary of the Navy and to the Chief of Naval Operations for providing independent parametric cost estimates of acquisition programs as part of the Department of Defense Cost Analysis Program. NCA is also responsible for validating cost estimates within the Department of the Navy, as directed.

In order to effectively perform its assigned mission, NCA requires analytical techniques which are both responsive to short lead-time tasking as well as sufficiently accurate to serve as a basis for comparison with the detailed cost estimates produced by the Program Managers of major defense systems. The first requirement dictates a model which is both easy to use and which requires relatively few input parameters. The second requirement dictates a model which is sensitive to more detailed system specifications and which includes sufficient documentation to be used with confidence when presenting independent cost estimates to Navy and OSD decision-makers.

The combination of these NCA requirements and the rapid pace of technological innovation in the field of avionics requires a set of innovative and flexible tools to relieve the cost analyst of the time-consuming tasks of locating appropriate data and developing a methodology for each estimate as it is needed.

B. PURPOSE/SCOPE OF PROJECT

The purpose of this project is to expand on an aircraft avionics and missile system retrofit installation cost model previously developed for NCA. During the previous effort, cost and technical data on avionics and missile system installations were collected from several sources, and at several levels of detail. The data was adjusted and formatted into a consistent, well-documented data base. Cost estimating relationships were developed and documented for each main category of the installation Work Breakdown Structure (WBS). Results of the previous effort are detailed in A Parametric Aircraft Avionics and Missile System Installation Cost Model - Data Base Report, Volume I, TR-8516-1, Management Consulting & Research, Inc., 20 June 1986 and A Parametric Aircraft Avionics and Missile System Installation Cost Model - Final Report, TR-8516-2, Management Consulting & Research, Inc., 31 August 1986.

The previous effort involved developing cost models for avionics and missile system installations into aircraft at the OSIP (Operational Safety Improvement Program) level. The OSI update programs often involved the installation, removal, or modification of several black-boxes within the aircraft. Each separate update action within an OSIP usually corresponds to a Technical Directive. Therefore, there are often several Technical Directives associated with an OSIP.

The current study was intended to utilize to a fuller extent all of the cost, program, and technical data previously collected, in an effort to break down the costs to the level of the separate black-box installation, removal or modification. During the previous effort, analysis was concentrated on costs at the total update program level. The aim of this effort is to examine different aspects of, and in more detail, some of the data that was collected previously, thus gaining further insight into the actual cost drivers of installation costs. It should be noted that only retrofit installations were considered in this study also; installations into production line aircraft are not included.

C. ORGANIZATION OF THE REPORT

This final report consists of two (2) volumes. Volume 1 contains the results of analysis and appendices. Volume 2 contains the raw and normalized TDSA data used in the data base.

Final report Volume I contains four sections. This section, Section I, provides the background, purpose/scope of the study, and organization of the report. Section II includes a discussion of the data collection procedures, data sources, and data normalization techniques. Section III pertains to the methodology used to develop the CERs, including hypothesis of relationships, regression analysis, validation of CERs, and documentation of CERs. Section IV documents the aircraft avionics and missile system installation cost model and results of analyses.

Appendix A provides complete documentation of all CERS. Appendix B contains the full data base used to derive the CERs and relevant CCB descriptions. Appendix C provides definitions of aircraft wiring classifications. Appendix D provides a full listing of the manhour data that was utilized in the installation learning curve analysis. Appendix E provides a description of the Navy aircraft modification funding and implementation cycle as a reference for those unfamiliar with the modification process.

Although this report is intended to be a stand-alone document, the reader may wish to refer to the reports from the previous effort (cited in Section B above) for clarification or detail in certain areas.

II. DATA COLLECTION/SOURCES/NORMALIZATION

This section describes the data sources and methodology used in formulation of the data base. The areas discussed are:

- data collection approach,
- data sources used to create the model, and
- data normalization.

A. DATA COLLECTION APPROACH

The data base used to create the avionics installation cost model is the result of combining the best data from several data sources. There were four key data sources which were tapped to create the "hybrid" data base used in this effort. Each data source had its strengths and weaknesses, which were taken into account when extracting data to be used for the data base.

Identification of the four data sources used was in part a result of research performed during a previous study for NCA, in which avionics installations were examined solely at the program level. It was recognized in the previous effort that there was insufficient time and funding to utilize to the full extent possible all of the data that had been collected and/or identified.

The intent in this effort was to extract the full benefit of the data previously collected, and to examine a lower level of cost and installation detail than before. New data sources were identified during the course of updating and re-examining the data that had been collected previously. Data was also collected from the newly identified sources to provide the most complete and accurate data base possible.

B. DATA SOURCES USED TO CREATE THE MODEL

There were four key data sources that were utilized in the creation of the model. They are as follows: Operational Safety Improvement Program (OSIP) Congressional Budget Submission backup data (for FY77 through FY89), outputs from the Technical Directive Status Accounting (TDSA) system, the Technical Directives (TDs), and Change Control Board (CBB) budget documentation. Each data source, and the manner in which it was used, is discussed in turn.

1. Operational Safety Improvement Program (OSIP) Budget Backup Data

The OSIP Congressional Budget Submission backup data was the primary source for cost data used in the previous effort. The backup data for the budget submission reflects actual costs from prior years used to justify the proposed budget for subsequent years. The OSIP items are submitted to the Chief of Naval Operations (CNO) OP-506 each year for planning, programming, and budgeting for the modification and modernization of in-service aircraft, weapon systems and power plants. The OSIP budget sheets are compiled by the aircraft program's financial manager, generally located at NAVAIR headquarters for aircraft in current production, or at the Naval Air Rework Facilities (NARFs) for aircraft that are no longer in production.

The OSIP data has proven to be the single most comprehensive source of <u>actual</u> cost data for aircraft modifications in existence. Although there are several other sources of budget cost data, they do not appear to be revised to reflect the actuals. Costs included in the OSIP backup are projections for the budget year to the projected end of the program, and estimates for the current year. Previous year estimates are updated to reflect actuals. The APN-5 funds are tracked, as soon as they are obligated, through the NAVY STARS (Standard Accounting and Reporting System). O&MN costs are monitored separately from the APN-5 costs. The O&MN expenditures may not be reflected until two years after the expenditures are made.

The OSIP costs are broken out by update program major cost element, and by funding type. Only updated costs (from previous years) were included in the data base. If expenditures for a cost element were projected beyond the year for which actuals were available, the cost element was not included in the data base. The rationale is that the actual cost plus projected cost for an element would be an estimate, and the expended portion only of a cost would be incomplete and would provide a skewed data base.

The OSIP data provided the historical costs from which any costs included in the data base were derived. Occasionally technical detail was obtained from the program description included in the budget backup. The installation manhours in the OSIP generally reflect estimates only, and are not updated consistently. Therefore, the installation manhours reported in the OSIPs were not utilized in this effort.

All normalized OSIP data and OSIP descriptions used to create the data base are available in A Parametric Aircraft Avionics and Missile System Installation Cost Model-Data Base Report, TR-8516-2.

2. Technical Directive Status Accounting (TDSA) System Data

Another key data source was the TDSA system. The TDSA is a means of centralizing information on the status of modification programs. It contains data on each TD, including description, estimated kit costs, estimated manhours, and reported manhours. Data are maintained and updated on the automated system at the Naval Air Maintenance Organization at Patuxent River, Maryland.

Computer runs of the relevant data had been obtained during the previous effort. However, in an attempt to obtain more complete and current data, trips were made to the facility to query the system and obtain the latest data. Because of familiarity with the system gained from the previous effort, we were able to obtain more data and in a more efficient format. The files were retrieved in a format allowing them to be transferable to Lotus 1-2-3 software.

The main use of the TDSA data was the reported manhours. These reflect the actual manhours to perform modifications as reported from the installing activity. The total manhours for the installations accomplished to date were obtained, wherever available. Similar data had been obtained for some OSIPs during the previous effort, at which point there were fewer installations to date reflected. Therefore, the two sets of data together provided a means of conducting learning curve analysis.

The TDSA was also used indirectly for the estimated kit costs it provided, and to provide a track between OSIP number and the related TD numbers. TDSA does not provide costs other than kit costs. The raw data obtained from TDSA is included in Volume 2. The TDSA data, normalized to reflect installation manhours at unit 100, is also included in Volume 2.

3. Technical Directive (TD) Data

A third important data source was the TD data that had been collected during the previous effort. TDs are the separate orders sent to the installation facilities to perform the changes required under an OSIP. The TDs associated with an OSIP were identified in TDSA. The TDs had been previously located at the NAVAIR library and the Naval Air Technical Services Facility (NATSF). Essential data was extracted from the TDs and entered into a standard format during the previous effort. The TDs were the primary source for technical data on the modifications. Examples of data obtained from them are: specific GFE units, cabling, and miscellaneous hardware installed and removed, and their respective weights, kit dimensions, and extent of wiring change. All TD data utilized in this effort is available in A Parametric Aircraft Avionics and Missile System Installation Cost Model-Data Base Report, TR-8516-2.

4. <u>Change Control Board (CCB) Documents</u>

The final major data source utilized was the CCB budget document, consisting of the Change Request/Directive, NAVAIR Form 13050/2, and supporting detail: Cost and Funding Summary, NAVAIR Form 13051/4 and Milestone Chart, NAVAIR Form 13051/5. Examples of a CCB Change Request/Directive and Cost and Funding Summary forms are provided in Exhibit II-1. These forms provide the information required for the Change Control Board to make the final decision to proceed with a modification.

There is generally a CCB document for each major TD, although sometimes a CCB document addresses more than one TD. Although the CCB is a budget document, it is based on proposed prices supplied by the contractor. It offers cost visibility at a lower level and in more detail than is generally provided in the OSIP. The CCB data was mainly used to allocate the OSIP costs to a lower level of the modification action, or to show a lower level of cost detail. Actual costs obtained from the OSIP could be allocated to the individual modification actions under the OSIP, using the budgeted costs for each modification action found in the CCB documents. For example, total update costs from the OSIP covering several black boxes could be allocated to individual actions to modify or install a single black box. CCB data also helped to identify what specific costs were included in the OSIP cost line items. It provided quantity data that was not always available in the OSIP (e.g., quantity of trainers), allowing calculation of unit costs.

6/2/83 UNCLASSIFIED

VOUGHT CORP. P.O BOX 225907 DALLAS, TX | VOUGHT ECP-572R3 | 791-24/R6

MODEL A-7E AIRCRAFT, ELECTRONIC WARFARE (EW), APR-43 ANTENNA RECONFIGURATION | 26-79

G. CORBE | WSN-052 | 2751 | 4 APR 83 | OPERATIONAL IMPROVEMENT

(a) VOUGHT LETTER 2-62000/31-255 DATED 25 MAR 1983

TOTAL TO BE MODIFIED	A-7E			130
CHANGED IN PRODUCTION				0
KITS PREVIOUS BUYS				0
KITS THIS BUY				130
BALANCE				0

N/A N/A

NOT STARTED

CPFY/I 12.0

AFC 411 AM 1

7

NONE

1. DUE TO RECONFIGURATION OF THE GFE: AN/ALR-45F, APR-43 EW AND THE AS-3252/APR-43 ANTENNA, IT IS NECESSARY TO amend AFC-411 to insure AFC compatibility.

2. REFERENCE (a) PROVIDED THE COST AND SCHEDULE IMPACT FROM VOUGHT CORP. TO ACCOMPLISH THE REQUIRED Amendment.

3. Nine AFC kits have been installed to date.

Approved 6/9/83

AFC-10: Non-recurring Engineering, INTERIM AND FORMAL TECHNICAL DIRECTIVE, DRAWINGS, SUPPLY DATA, 130 ea. AFC KITS, VSPARES (NOTE: IAFC 411 AM 1 TO COVER RE-DRILLING OF EXISTING ANT MOUNTING BASE)(previously authorized) 791-24/R4

AIR-413: PROCURE 2 ea. WST KITS. (REQUIRES EXTENSIVE SOFTWARE CHANGE TO TRAINER EW SIMULATION)

N0001983PDBDCAG Rev C7 7/1/

N0001983PDBDCAS Rev C2

130 ea. A-7E

Exhibit II-1. CCB DOCUMENT EXAMPLES

UNCLASSIFIED

731-291 R6

A					78,800	(83)		AIR-102D
B					INCL IN "A"	(83)		AIR-102D
C					6,258	(83)		AIR-102D
D								
E					450	(83)		AIR-102D
F					INCLUDED IN "A"	(83)		AIR-102D
G					(350) 14,500	(83)		AIR 102D
H					0			PMT/FMT
I								
J				(4)	96,600	(83) ✓		AIR-102D
K								
L								
M					800			AIR-4123
N								
O					15,600	(83)		AIR-102D
P					1,164	(83)		AIR-102D
Q								
R								
S					80,000	(83) ✓		AIR-102D
T								
U								
V				Total	323,772			
W								

WSH-052
WSH-05 — T. C. McKay
AIR-55211F
WSH-0534
AIR-4105D — 4/6/83
AIR-102D — 6/3/83
WSH-05A
PMA-255
APC-10-3
AIR-551

to Vought	A,B,C,F,M,	C APC-10
Pubs	O	NATSF
4613 ... Vought	J	AIR-4131
[illegible]	T	[illegible]

Exhibit II-1. CCB DOCUMENT EXAMPLES (CONT'D)

MANAGEMENT CONSULTING & RESEARCH, INC.

COST AND FUNDING SUMMARY

] ATTRITION
] PRODUCTION
] RETROFIT

ECP/RAMEC No. 572 R 3
ECP/RAMEC Originator VOUGHT
ECP/RAMEC Sponsor WSM-052

Logistics Manager WSM-053X
Equipment A-7E E.W. IMPROVEMENT
OSIP No. 34-79

CCB No. 81-241R10
TD No.
TD Category

ELEMENT	[illegible]	[illegible]	QTY BY FY			TASKED ACTIVITY	IMPL ACTY (NAVAIR CODE)	TYPE FUNDING	1ST YEAR (FY 83) FUNDING COST	1ST YEAR (FY 83) FUNDING SIGN OFF	2ND YEAR (FY 84) FUNDING COST	2ND YEAR (FY 84) FUNDING SIGN OFF	3RD YEAR (FY 85) FUNDING COST	3RD YEAR (FY 85) FUNDING SIGN OFF
	7 Mo	12	83	84	85									
RETROFIT - NONRECURRING						Vought	APC-10	APN-5	70,100					
a. TECH DIR PREP (AMENDMENT)						Vought	APC-10	APN-5	425K					
b. TECH DIR VERIFICATION														
c. TECH DIR PRINT & DISTR						NAPSO	NATSF	APN-5	450					
d. DRAWINGS						Vought	APC-10	APN-5	incl in NR					
e. SUPPLY DATA						Vought	APC-10	APN-5	incl in NR					
f. TOOLING						NA								
RETROFIT - RECURRING														
a. TOOL KITS						NA								
b. KITS FOR BASIC EQUIPMENT			30			Vought	APC-10	APN-5	44,500					
c. MOD OF BASIC EQUIPMENT				77		SHOEMT/IF	no cost ...		...	[illegible]				
GFE						NA								
LOGISTICS SUPPORT														
a. TRAINING						NA								
b. KITS FOR MAINT.						NA								
c. MOD OF MAINT.						N								
d. KITS FOR INST/OTH			2			Vought	A16413	APN-5	96,400					
e. MOD OF INST/OTH						NA								
f. KITS FOR SPARES						NA								
g. MOD OF SPARES						NA								
h. NEW SPARES						Vought	AIR 412	APN-6	800	[illegible]				
i. REPAIR PARTS						NA								
j. TECH MANUALS PREP						Vought	NATSF	APN-5	15,000					
k. DOCUMENTATION REPRO & DISTR						NPPSO	NATSF	APN-5	2100					
l. MAINTENANCE PLAN						NA								
m. INTERIM SUPPORT														
n. SUPPORT EQUIPMENT						Comm/SRA	AIR-552	APN-5	10,000					
o. SUPPORT EQUIPMENT SPARES & REPAIR PARTS						↓								
p. NEW START DATA PKG - DEPOT INTERSERVICING														

PREPARED BY N. Ball | CODE WSM-053C | TELEPHONE NO. 912-2751 | DATE 4/6/83 | APPROVED BY [signature] | CODE 4105D | DATE 4/6/83

NAVAIR FORM 13061/4 (REV. 6-78)

Previous issues of this form are obsolete

Exhibit II-1. CCB DOCUMENT EXAMPLES (CONT'D)

MANAGEMENT CONSULTING & RESEARCH, INC.

Files of the more recent CCB documents, and also related documentation (contractor modifications, Purchase Orders, proposal data, etc.) are maintained at AIR-02. The CCB documents that were not active during FY84 were sent for storage in archives. It is apparently a very difficult and time-consuming task to obtain older CCB data from the archives (which is actually a large warehouse), so retrieval of them was not attempted in this effort. We limited the search for CCB documents to those OSIPs for which we had all of the TD data. Of these, several of the related CCB documents were either archived or were proprietary and could not be disclosed.

C. DATA NORMALIZATION

In order to achieve a data base of comparable data points for use in formulating CERs, it was necessary to perform several steps to normalize the data. Costs were formatted using a Work Breakdown Structure (WBS), and were escalated/deflated to constant-year dollars. The Aircraft Fiscal Year Escalation Indices for 1985 from NAVAIR 5243 were used to adjust costs to base year dollars. The electronics composite rate was used to adjust the material cost elements. A "loaded" (including overhead) electronics labor rate was used to adjust labor-intensive cost elements. The escalation indices applied to recurring costs were weighted to reflect an expenditure profile of 70 percent for the first year, 20 percent for the second year, and 10 percent for the third year. Using learning curve analysis, a methodology was developed and applied to normalize the installation manhour data to comparable cumulative averages.

1. Work Breakdown Structure (WBS)

MCR developed a WBS during the previous effort specifically for the avionics/missile installation study. The same WBS was used here, with the exception that the non-recurring breakout was slightly modified to provide for the detail from the CCB documents. The WBS format is presented in Exhibit II-2. The OSIP data was mapped into the WBS structure during the previous effort (see TR-8516-2 for details). The WBS structure provides a standard means of grouping the program costs to allow for comparison of costs between programs and use in CERs.

2. OSIP Budget Backup Data

The WBS is consistent with the way the costs are broken out in the OSIP backup data. Individual cost line items in the OSIP were allocated to the appropriate cost sub-category (such as non-recurring engineering, tooling, etc.). If the sub-category was not stated or implied, it was allocated only at the major cost level (such as non-recurring). When a cost could belong to more than one category, and could not readily be allocated between them, it was footnoted and attributed to what was judged to be the major category.

The majority of the OSIP data came from work performed during the previous effort. However, one program was updated to reflect additional historical cost data obtained in the FY88/89 Congressional Budget Submission. During the previous effort, all available historical OSIP costs for relevant OSIPs were included, regardless of the amount of technical detail available. During this effort, only those OSIPs were included in the data base

NON-RECURRING (APN-5)
- ENG/DESIGN/DEV/TEST
  - NRE
  - TOOLING
  - TEST/GOV TEST
- DRAWINGS
- TECH DIRECTIVE
- TECH DIRECTIVE PRINTING AND DISTRIBUTION
- DATA/PUBS
  - PUBLICATIONS
  - PUBLICATIONS PRINTING AND DISTRIBUTION
- INTEGRATED LOGISTIC SUPPORT

RECURRING (APN-5)
- KITS
- HARDWARE
- RECURRING ENGR
- REFURBISH/UPDATE

PECULIAR SUPPORT EQUIP (APN-5)
- PSE ENGR
- PSE MOD KITS
- PSE HARDWARE

TRAINER (APN-5)
- TRAINER ENGR
- TRAINER MOD KITS
- TRAINER HARDWARE

SPARES (APN-6)

INSTALLATION (O&MN)
- AVIONICS INSTALLATION
- PSE INSTALLATION
- TRAINER INSTALLATION
- MODIFICATION OF SPARES

INTEGRATED LOGISTIC SUPPORT (O&MN)

Exhibit II-2. AIRCRAFT/AVIONICS MODIFICATION DATA BASE WBS where all of the relevant TD data was also available. The exception to the rule was that the aggregate kit costs from the historical OSIP data were utilized, even if all TDs for the OSIP were not available, if they could be allocated to individual kit costs using the TDSA kit cost estimates.

3. CCB Data

The historical OSIP data was allocated to component modification actions of an update program based on the CCB budgets, where possible. The sum of the CCB budgeted cost elements was compared to the OSIP historical data. The sum of the CCB data had to be compared to the raw (then-year) OSIP data, as it was in then-year dollars. Only if the match was reasonable (within 10 percent), then the normalized OSIP costs were allocated to the individual component modification actions, in proportion to their budgeted amounts. This analysis and allocation was performed for each cost element separately. This methodology eliminated the need to re-normalize the data to constant-year dollars. If the summed CCB document and historical OSIP costs did not match reasonably for a particular cost element, then the allocation was not attempted and the cost element was not included. The exception occurred where all of the costs in an OSIP cost element could be attributed to one modification component, and allocation was not necessary for that cost element.

4. TDSA Data

TDSA provides estimated or actual kit costs for individual TDs, when available. The kit costs reflected in an OSIP may be the sum of these kit costs for individual TDs within the OSIP. When estimated or actual kit costs for all of the TDs related to an OSIP were available, and the actual total program kit cost was available from the OSIP data, the actual total program kit cost was allocated to the individual kits. Only the kit costs for which there were associated TD data were included in the data base.

5. Learning Curve Application

TDSA also provides estimated and reported installation manhours. The reported manhours are shown as total manhours to-date to perform total installations to-date. The total manhours and total installations figures are used to derive the estimated cumulative average installation manhours at a particular installation sequence number. It was necessary to perform learning curve analysis so that these data points could be normalized to installation manhours at the same installation sequence number. Only by this means, would the data points be comparable. The methodology used to perform the learning curve analysis is explained in detail below.

The candidate data set for learning curve calculation included those cases where there were reported manhours in the TDSA from both the 1986 and 1987 data collection efforts and where there had been installations accomplished between 1986 and 1987. The following rules were applied to the original candidate data set to obtain a homogeneous and representative data set from which to derive useful average learning curves. The average learning curves were then applied to those cases where the average installation manhours were only available in the 1987 data collection to estimate a cumulative average cost at unit 100.

Data points from the candidate set were deleted if:

- They were administrative modifications. Examples are: OSIP 3-75, AVC 1782, Amendment 1 which corrects a typographical error in the testing instructions; OSIP 28-75, AFC 239, Amendment 1 corrects the basic serialization and adds serial numbers for FY80 funding; OSIP 28-75, AFC 239, Amendment 2 adds serial numbers for FY81 funding. Administrative modifications usually involve low manhours, and do not directly relate to the modification task being performed.

- The data point was a kit other than the A1 kit (e.g., A2, A3), except as noted below. These are often the same modification to the same model of aircraft, but to a different configuration. To avoid double-counting, only one kit per TD was counted. The exception occurs when A1 and A2, etc. are complimentary parts of a single modification kit.

- The data point was not for basic equipment, but rather spares, etc. (i.e., not an "A" kit).

- The calculated learning curve was above 120 percent or below 60 percent. It was assumed that some reporting errors or other unknown factors were involved if the calculated learning curve was outside that range. This range was chosen to exclude a number of data points that were judged to be outliers.

- The change did not involve avionics.

- The modification had been cancelled and replaced by a new TD.

- The TDSA data appeared incorrect (e.g., quantity installed decreased over time, or quantity installed increased while total manhours remained the same.)

- The modification was not internal to the aircraft.
- It was not clear if all parts of the kit were included.

Data points from the candidate set were combined if:

- The kit was in two or more parts. The installation manhours were combined and the computed learning curve used as one data point in this case.

The 12 cases within the acceptable data set where there had been less than ten installations reported between the 1986 and 1987 data collections were segregated. This subset was analyzed to determine if the learning curve calculations would be unreliable because of the small quantity change between years. They exhibited a distribution of calculated learning curves consistent with that for the entire 59 data points. Consequently, the subset was not excluded from the data set used to calculate average learning curves.

The data set of candidates used for calculation of average learning curves is included as Appendix D. The data set includes justification for inclusion or exclusion of each data point in calculating a representative average. Averages were calculated from the data for three categories: airframe changes, avionics changes, and general. The average learning curve for airframe changes was 81 percent, for avionics changes 97 percent, and for the total data set 82 percent.

The following rules were applied to the entire data set for normalization to cumulative average at unit 100.

- If the total reported quantity for the installation was above 65, and a learning curve could be calculated using data obtained during the two data collection efforts, the calculated learning curve was used to obtain average manhours at unit 100.

- If the total reported quantity for the installation was above 65, and no learning curve could be calculated, or if the total reported quantity of installations was less than 65, an average was used. The calculated average learning curve for the particular type of installation (AFC or AVC) was applied to obtain average manhours at unit 100.

Again, only those data points were included in the data base that also had available technical data parameters.

A notable discrepancy was found between the rather steep learning curve reflected in the TDSA data and the nearly flat learning curves reflected in the OSIP installation costs. Learning curve calculations had been performed on the OSIP installation costs in the previous effort. Upon further investigation, and conversation with NAVAIR personnel, several reasons for this discrepancy were identified.

First, little or no learning is incorporated into the budgeted installation costs (in the OSIPs) to allow for the possibility that the installations might be performed at a new site (e.g., they could stop performing them at Norfolk, and begin at the NARF, Alameda).

Secondly, the installation costs include "over-and-above" costs that are not labor costs directly related to performing the modification. These extra costs may be quite substantial, and may include such costs as: repair of repairables, fixing problems found with the aircraft upon inspection when received, supply parts, "customer service," standardization of configurations, and other miscellaneous necessary, but unrelated, tasks. The contractor may estimate the total installation cost, including the "over-and-above" costs, and divide by the wage rate to supply the estimated manhours reflected in the OSIP.

Finally, the O&MN costs (including the installation) are not revised as consistently as the APN-5 funding, to reflect actuals. The O&MN costs may not be reported until two years after they are expended. By the time they are reported, the program may be ending and no more budget submissions will be made, that is, the accounting never "catches up" to the modification budget documentation. Also, the O&MN money is separately monitored, and the responsible activity tracks the expenditures on a document other than the OSIP budget backup. Therefore, discrepancies in the OSIP data may go unnoticed.

Because of the above reasons and the extensive manhour data included in the data base, it is suggested that the TDSA modification manhour CERs are the best means of obtaining actual direct labor cost estimates from this model.

6. <u>Technical Directive Data</u>

Much of the technical detail provided on the TDs was utilized during this effort. Some technical parameters that were included in the data base had to be derived from the data available on the TD. Examples are: segregating the equipment being installed and removed from the aircraft into unit, cabling, and miscellaneous hardware categories, calculating their respective weights, and calculating the number of boxes and units installed and removed. All "AN/"-nomenclatured systems were counted as black-boxes. All main components of the system (receivers, transmitters, etc.) were counted as units. The wiring change was measured on a scale of 0-4, and the descriptions for each category are shown in Appendix C. Equipment types were categorized according to primary and secondary purpose. Percentages were calculated for the number of manhours for each labor category (electrical, structural, mechanical) relative to the total expected manhours for the installation. For example, if the expected labor breakdown (shown on the TD) were electrical technician-20, structural mechanic-40, and general mechanic-10, the breakdown would be 29 percent, 57 percent, and 14 percent, respectively.

III. METHODOLOGY

This section describes the methodology employed to develop the cost and installation manhour models. The aircraft/avionics modification data base was used to develop CERs, and to perform related analysis. There were four main steps to the CER development methodology which are discussed below. They are:

- hypothesize relationships,
- perform the regression analysis
- validate CERs, and
- document the CERs.

The step of hypothesizing relationships was performed during initial data collection, as it was imperative that the necessary data was collected and structured into the data base so that logical relationships could be tested.

A. HYPOTHESIZE RELATIONSHIPS

The following discussion describes:

- the hypotheses tested for various WBS elements,
- stratifiers used to segregate data or modify CERs, and
- use of learning curves.

1. Hypotheses

Hypothesizing relationships between the WBS elements and the numerous potential cost drivers requires an understanding of the cost impact of the physical, performance, and technology parameters. Relationships based on sound engineering or economic principles were hypothesized, then tested by regression analysis.

Some relationships resulting from the regression analysis had appealing statistics, but were rejected during the validation process. Hypotheses were tested primarily for: modification non-recurring costs, modification kit cost, modification installation cost, and modification installation manhours. Factor analysis was performed on elements of the non-recurring cost.

Due to lack of sufficient historical cost data, relationships were not developed for all of the WBS elements.

The main cost elements that were tested are discussed in the paragraphs below.

a. <u>Non-Recurring Costs</u>

Non-recurring costs include design, development, engineering, test, tooling, and preparation of the change directive which are independent of the items procured. Non-recurring is funded under APN-5. If the change is also made to production aircraft, only that portion of the non-recurring cost directly attributable to the retrofit is funded under the retrofit program. Cost associated with retrofit items, i.e., publications and modification of spares, are funded by the production program, and are listed under the "production" column in the CCB budget data.

The following parameters were hypothesized and tested as cost drivers for non-recurring costs:

- Number of black-boxes (systems) installed, removed or modified;
- Number of units (components) installed, removed, or modified;
- Weight of units installed or removed;

- Total weight installed;
- Extent of wiring change;
- Hardware cumulative average cost;
- Kit cumulative average cost;
- Kit dimensions; and
- Kit weight.

The sub-elements of non-recurring consist of the following cost elements.

- Engineering Design, Development, and Test. These costs, not dependent on the number of items produced, are for the engineering data describing the change. Charges include, but are not limited to those for engineering work hours, prototype or validation of hardware or software.

- Drawings. Non-recurring costs are for preparation of engineering drawings describing the change.

- Technical Directive Preparation. Included are costs for Technical Directive (TD) preparation including those for technical writing drafts of the reproducible master copy and applicable charges for preparation of interim TDs.

- Technical Directive Printing & Distribution. Costs are for printing and distribution of the TD.

- Data (Technical Data and Information). These costs include the means for communication of concepts, plans, descriptions, requirements, and instructions relating to technical projects, material, systems, and services. They may include specifications, standards, engineering drawings, associated lists, manuals, and reports, including scientific and technical reports, and they may be in the form of documents, displays, sound records, punched cards, and digital or analog data.

- Publications. Costs for new and or revised publications describing the proposed changes. Charges include manhours and materials required for technical writing and illustration of new publications or change pages for publication updates.

- Publications Printing & Distribution. Costs for printing and distribution of new and revised publications describing the proposed change.

- ILS. Included are costs for LSA and revisions, maintenance plans and revisions, and other ILS not dependent on the number of items produced.

CERs were developed for total non-recurring cost. A table of factors was prepared for the sub-elements of non-recurring cost. The mean percentage of each sub-element to total non-recurring cost was calculated. As the breakout for all elements was not available in all cases, the sum for the mean percentages did not equal 100 percent. Therefore, the percentages were adjusted to total 100 percent. This allows the analyst to estimate a typical breakdown of non-recurring cost elements, under the assumption that all elements will be present.

b. Recurring Kit Costs

Basic kit costs include recurring costs for manufacture or purchase of retrofit kits for the system or equipment affected by the change. In general, avionics changes require a kit to modify a system, and airframe changes require a kit to install a system into the airframe. In-warranty retrofit kits are funded under the production program. This cost includes any prototype that may have been used by the manufacturer for "validation" of the design and any initial kit supplied to the NARF for "verification." If prototype kits were included in the non-recurring costs in the raw data, they were allocated to kit costs during normalization. The basic kits may apply to either airframe changes or to avionics changes.

There may be recurring costs for manufacture or purchase of retrofit kits for system or equipment spares and trainers affected by the modification. Spare kits for avionics changes may be applicable to components, such as printed circuit boards.

The following parameters were hypothesized to be the cost drivers for recurring kit costs and were tested by regression analysis:

- Number of black-boxes installed, removed or modified;
- Number of units installed, removed or modified;
- Weight of units installed or removed;
- Weight of units plus installation hardware (brackets, etc.) and cabling installed or removed;
- Extent of wiring change;
- System hardware cumulative average cost;
- Installation complexity (percent of weight installed that is not system weight);
- Kit dimensions; and
- Kit weight.

c. Recurring Installation Labor Costs

Installation labor costs refer to the physical installation of airframe or avionics changes. They include costs for the modification of systems or equipment by depot rework, depot field team, commercial rework or commercial field team. Charges for changes performed at the organizational and intermediate levels are not reflected. Labor-related costs for retrofit, testing and TD verification are included. Once an airframe change has been made, the installation of the "black-box" hardware system may be a simple plug-in operation. Other avionics black-boxes may require modification by avionics changes to work with the new black-box, however. Other avionics changes may be made completely independent of any aircraft.

The hypotheses for CERs for installation labor costs included the following parameters:

- Number of black-boxes installed, removed or modified;
- Number or units installed, removed or modified;
- Weight of units installed or removed;
- Weight of units plus installation hardware (brackets, etc.) plus cables installed or removed;
- Extent of wiring change;
- Kit cumulative average costs;
- Kit weight;
- Kit dimensions; and
- Aircraft avionics (already installed) equipment weight.

2. <u>Stratifiers</u>

Stratifiers were also used to logically segregate the data points in the data base. The stratifiers that were tested for effect on the CER were the following:

- Aircraft type,
- Equipment type,
- Installer,
- Form-fit-function, and
- Box modifications or installations/removals.

a. Aircraft Type

The modifications were categorized by the type of aircraft to which they apply. The categories are:

- Fighter/Attack,
- Airborne Early Warning (AEW),
- Anti-Submarine Warfare (ASW),
- Helicopter, and
- Cargo.

b. Equipment Type

The modifications were categorized by the type of equipment that was being installed or modified. The equipment categories include those used in the previous effort, plus three additional categories that became relevant after examination of the new data collected. The original categories used were:

- Communications,
- Navigation,
- Identification,
- Electronic Countermeasures,
- Electronic Support Measures,
- Radar,
- Electro-Optical, and
- Missile.

The new categories that were added are:

- Armament,
- Surveillance, and
- Fire Control.

The equipment was also described by equipment type and equipment purpose. This was indicated by a code letter indicating each parameter. The equipment type and purpose letters are usually the second and third letters of the "AN/-" nomenclatured equipment installed or modified. The equipment type and purpose codes correspond to the definitions in the AN/- Nomenclature system designations, and are not listed here. The exceptions are the type codes "W" and "Z", which denote armament and airframe changes, and the purpose codes "P", "U", and "Z", which denote pylons, wiring, and structure changes, respectively.

c. Installing Activity

Modifications were also stratified by the modifying agency and the method of performing the change. The possible variations of modification method and installer are shown in Exhibit III-1.

Information on the installing activity was obtained either from the OSIP description, the TD, or the TDSA data.

d. Form-Fit-Function

Form-fit-function replacements were segregated in an attempt to enhance the CERs. A modification was denoted as form-fit-function only when so described in the OSIP justification or in the TD. It was expected that a form-fit-function replacement would involve less non-recurring cost and installation labor, as it is a direct replacement for a similar piece of equipment.

Method	Installer		
	Contractor	NARF	Organization/ Intermediate
Component Turn-Around (CTA)	X	X	
Standard Depot Level Maintenance (SDLM)	X	X	
Drive-In (or Fly-In) (DI)	X	X	
Field Modification Team (FMT)	X	X	
Not Specified (N/S)	X	X	
Maintenance Personnel (at no additional cost) (O&I)			X

X = Possible method/installer combination

Exhibit III-1. AIRCRAFT/AVIONICS MODIFICATION CATEGORIES

e. Box Modifications or Installation/Removals

The modifications were classified according to boxes installed, boxes removed, and boxes modified. The data base was separated according to whether the modification involved modification of a box only, or installations and removals of boxes. This distinction was made to segregate avionics changes from airframe changes. The TD number contains two digits which describe the type of change. The numbers "50" denote an airframe change, and "54" denote an avionics change. However, examination of the TD contents showed that this convention was not always followed. Therefore, the TD number was not always followed to categorize the change as an airframe change (box installation/removal) or an avionics change (box modification). Rather, the data base was segregated according to whether boxes were modified only, or boxes were installed/removed based upon the TD description.

3. Complexity Factors

Complexity factors were tested as another stratifier in CER development. Complexity factors were developed that gauged the complexity of:

- Wiring changes due to the modification;
- The installation, defined by the percentage or total weight installed that is miscellaneous hardware and cabling;
- The installation, defined by the percentage of total weight installed and removed that is cabling;

- The aircraft, defined by the percentage of aircraft weight that is avionics equipment and avionics installations; and
- The aircraft, defined by the aircraft avionics weight divided by the fuselage volume.

Details on the derivation and definitions of th aircraft complexity factors can be obtained in TR-8516-2.

4. Constant Terms

In some of the CERs included in the model, the constan term was repressed, and the curve "forced" through the origin This was done when the constant term was not very significant often because there were data points near the origin. Attempt to segregate the data sets into groups was made when possible but segregation was not always feasible due to limitations of th data set.

B. PERFORM REGRESSION ANALYSIS

MCR tested the hypothesized relationships using regressio analysis. This process was automated on MCR's IBM PC-compatibl microcomputers. The normalized data bas as placed into a LOTU 1-2-3 file.

These files were transferred to MCR's statistical package which contains a data base system that facilitates adding changing, deleting, transforming or selecting variables fo regression. Complete statistics of the regressions were outpu so that the CERs could be evaluated based on these statistics These statistical measures apply to the overall regressio equation as well as to individual coefficients and parameters Those measures that apply to the coefficients and parameters are

- standard error - the standard error of the coefficient value, and
- t test - a statistical test of whether the coefficient is significant.

The statistical measures that apply to the overall CER are:

- R^2 (Coefficient of Determination) - a statistical measure indicating the proportion of total variation that is explained by the regression equation;
- F ratio - a statistical test of the significance of the regression equation; and
- standard error of the estimate - statistical measure of variation of the data from the regression equation.

Additional tests of the regression equations were made by residual analysis using the outputs of the statistical analysis program:

- table of predictions and residuals - tables of predicted values and the difference between actual and predicted values;
- scatter plots - various plots showing the scatter of actual values compared to the regression equation; and
- Durbin-Watson Statistic - a statistical test of correlation of the residuals.

Examination of the table of predictions and residuals and scatter plots revealed whether:

- there were outliers,
- there were omitted variables,
- the relationship was non-linear,
- the residuals were correlated instead of independent,
- the variance of the residuals was not constant, or
- the residuals were not normally distributed.

C. VALIDATE CERs

MCR validated the CERs by two principal methods to assure that their use will result in reasonable and usable estimates. Validation is not a clearly defined process. The analyst's judgement was a crucial element in the evaluation of CERs and the presentation of the results to demonstrate their validity. These methods employed to test the validity of the CERs included:

- engineering evaluation of coefficients, and
- examining the residuals.

MCR carefully examined the coefficients and signs to determine whether the expected relationships and weighing actually occurred.

The statistical analysis program computes the residuals for each CER. These are the differences between the actual cost of each data point and the predicted cost using corresponding parameters in the CER. The residuals were examined to determine if there were any systematic errors in the estimating formula.

D. DOCUMENT CERS

The documentation of the aircraft/avionics modification/ installation CERs developed in this study is presented in two parts. The parts consist of the following:

- a model for use by the analyst in preparing cost or manhour estimates for aircraft/avionics modifications, and
- detailed documentation of individual CERs included in a separate appendix.

1. <u>Aircraft/Avionics Modification Cost Model</u>

MCR documented the CERs and results of factor analysi in the form of the Aircraft/Avionics Modification Cost Model The CERs developed are applicable to different phases of th estimating process. As the modification program progresses parameters may become known that were not available during th planning phase. The model is presented in a matrix that denote the applicable CERs or factors for different elements, an different types of changes (box installation/removal, bo modification, or general) to be estimated. The cost mode applicability matrix and estimating relationships are detailed i Section IV.

The CERs that were derived, as well as the descriptiv information, are provided in Section IV. The descriptiv information for the CERs includes:

- the CER formula,
- description of the parameters,
- sample size,
- the adjusted coefficient of determination (R squared),
- standard error of the estimate (SEE),
- mean of the dependent variable, and
- ranges of all the parameters.

Accompanying each is a discussion of uses and limitations of th CER and pertinent comments on its derivation.

Various CERs are provided in each category so that th analyst can utilize any parameters known at the time of estima tion.

Factors were used for the elements of non-recurring costs. The table of factors, and description of derivation and applicability, is also presented.

2. CER Documentation

Documentation of the CERs is provided in Appendix A. The supporting documentation is presented in order of the "Reference Numbers" that are used in the cost model matrix. The Reference Number in the cost model matrix corresponds to the Reference Number listed before each relationship in the modification cost model discussed in Section IV, and in the CER documentation, Appendix A.

Supporting documentation of the CERs derived includes the following items:

- statistical measures of relationship including:
  - coefficients,
  - standard error of the coefficients,
  - t-statistics of the coefficients,
  - sample size,
  - standard error of the estimate,
  - R squared,
  - adjusted R squared,
  - F-statistic, and
  - Durbin-Watson statistic,
- residual plot;
- standard plot of fitted versus actual values;
- the data sample used in the derivation, including the relevant OSIP number, fitted values, and residual values; and

- graph of independent versus dependent variable (if linear regression with one regressor), or actual versus fitted values (if multiple regressors or exponential form).

For the exponential relationships, the fitted and residual values are transformed from the logarithmic form back to the actual values.

IV. AIRCRAFT/AVIONICS MODIFICATION COST MODEL

This cost model is the result of an effort to expand on analysis performed during a previous avionics and missile system installation cost study. In the previous effort, retrofit modification programs were analyzed at a more aggregate level, the update program level. It was hoped that using the data sources to further break down the modification costs to separate modification actions would allow identification of stronger estimating relationships.

Data was utilized from data sources identified during the previous study, and from newly identified sources, to provide the most detailed and accurate data base possible. As a result of extensive research, and contacts with NAVAIR and NAMO personnel, it is felt that the data sources utilized in this effort are the best available for the purpose of avionics installation costing.

When the costs and manhours are examined at lower levels, however, it is suspected that the "noise" inherent in the data becomes more disruptive to the relationships. Examples of possible influences on the data are:

- inclusion in reported data of additional costs necessary for the overall update program but not to the particular modification;
- inconsistent cost and manhour reporting; and
- unknown factors in the modification scenario.

In effect, there are too many variables affecting a single modification action for the costs to lend themselves to strong parametric relationships.

The strongest relationships found in the data are based on inputs that may not be known during the conceptual phase of a modification program. The relationships between readily available input parameters and installation costs were less apparent. The CERs that were developed in the previous study, "A Parametric Aircraft Avionics and Missile System Installation Cost Model," completed 20 June 1986, may still be more useful for certain cases. However, this effort provided some strong relationships for avionics modifications, not found during the previous effort. Also, it utilized a source of reported manhour data that was not incorporated into the earlier CERs.

It should be noted that the results of this effort include the data base which can be used for analog estimating, as well as the resultant CERs. The data base may be used for reference where there are insufficient data points, or too tenuous a relationship, to develop a parametric estimating equation. In some cases, the use of the data base to obtain analog estimates may be the better course for the estimator of aircraft/avionics modifications.

The CERs and factors derived for retrofit aircraft/avionics modifications are presented below. They are discussed in the following order: Non-recurring costs, installation kit costs, installation labor costs, and installation manhours. The relationships are numbered sequentially. Within each of the above groups, the relationships are listed in order of preference. The reference numbers correspond to those shown in the model matrix, Exhibit IV-1. Relationships were developed to apply to the following cases:

- Installations/Removals of "black-box" hardware. GFE- or CFE-supplied black-boxes are installed in an aircraft. Removal of obsolete black-boxes may, or may not, accompany the installation(s).

- Modification of hardware. The black-boxes themselves are modified, with no change made to the aircraft. The modifications can be made to black-boxes on the bench and later exchanged for unmodified units in one, or several, aircraft types.

- Combination of Installations/Removals and Modifications of black-boxes. All data points were combined to be used in the regressions.

The model matrix, Exhibit IV-1, shows the breakout of the relevant relationships to the cost elements. The cost matrix is presented in three sections corresponding to the three modification types: box installations/removals, box modifications, and general (both). They are ordered within each element/type "block" by preference. The preference order of the relationships was determined by the statistical measures of the CERs, and by the probable availability of the input parameters. It should be noted, however, that even if an input parameter value is not available, it is possible that the value can be estimated from another of the model relationships or other means available to the estimator. Each relationship is designated by a distinct "Reference No.", which is traceable to the model matrix, for easy reference and location of relevant relationships.

A. <u>NON-RECURRING COSTS</u>

Non-recurring costs include design, development, engineering, test, tooling, and preparation of the TD, publications

BOX INSTALLATIONS/REMOVALS			
DEPENDENT VARIABLE	REFERENCE	PAGE #	INDEPENDENT VARIABLE (S)
NON-RECURRING $	R#1	P. IV-7	NO. OF BLACK-BOXES INSTALLED
	R#2	P. IV-9	TOTAL WEIGHT INSTALLED
	R#3	P. IV-9	NO. OF BLACK-BOXES INSTALLED, COMPLEXITY FACTOR FOR WIRING CHANGE
	R#4	P. IV-10	MANHOURS TO INSTALL (AT UNIT 100)
	NON-RECURRING ELEMENT TABLE	P. IV-8	TOTAL NON-RECURRING COST
KIT $	R#7	P. IV-12	HARDWARE CUM AVE COST, NO. OF UNITS (COMPONENTS) INSTALLED
	R#8	P. IV-13	HARDWARE CUM AVE COST
	R#9	P. IV-13	HARDWARE CUM AVE COST
	R#10	P. IV-14	HARDWARE CUM AVE COST, SHIPPING DIMENSIONS OF KIT
	R#11	P. IV-14	HARDWARE CUM AVE COST, SHIPPING WEIGHT OF KIT
MODIFICATION LABOR $	R#14	P. IV-17	SHIPPING DIMENSIONS OF KIT
	R#15	P. IV-18	KIT CUM AVE COST
MODIFICATION MANHOURS	R#23	P. IV-23	HARDWARE CUM AVE COST, WEIGHT OF AVIONICS ALREADY IN AIRCRAFT
	R#24	P. IV-23	WEIGHT OF UNITS (COMPONENTS) INSTALLED, COMPLEXITY FACTOR FOR WIRING CHANGE
	R#25	P. IV-24	HARDWARE CUM AVE COST, PERCENTAGE OF WEIGHT INSTALLED AND REMOVED THAT IS CABLING
	R#26	P. IV-25	HARDWARE CUM AVE COST, WEIGHT OF MISCELLANEOUS HARDWARE AND CABLING INSTALLED
	R#27	P. IV-25	WEIGHT OF CABLING INSTALLED, WEIGHT OF CABLING REMOVED
	R#28	P. IV-26	HARDWARE CUM AVE COST, SHIPPING DIMENSIONS OF KIT
	R#29	P. IV-26	HARDWARE CUM AVE COST, TOTAL WEIGHT INSTALLED INTO AIRCRAFT

Exhibit IV-1. AIRCRAFT/AVIONICS MODIFICATION COST MODEL REFERENCE MATRIX

BOX MODIFICATIONS			
DEPENDENT VARIABLE	REFERENCE	PAGE #	INDEPENDENT VARIABLE (S)
NON-RECURRING $	R#5	P. IV-10	KIT CUM AVE COST
	R#6	P. IV-11	ESTIMATED INSTALLATION MANHOURS
	NON-RECURRING ELEMENT TABLE	P. IV-8	TOTAL NON-RECURRING COST
KIT $	R#12	P. IV-15	WEIGHT OF UNITS (COMPONENTS) INSTALLED, COMPLEXITY FACTOR FOR WIRING CHANGE
	R#13	P. IV-15	WEIGHT OF UNITS (COMPONENTS) INSTALLED, SHIPPING WEIGHT OF KIT
MODIFICATION LABOR $	R#16	P. IV-18	NO. OF UNITS (COMPONENTS) INSTALLED AND MODIFIED, TOTAL WEIGHT INSTALLED INTO SYSTEM
	R#17	P. IV-19	KIT CUM AVE COST
MODIFICATION MANHOURS	R#30	P. IV-27	SHIPPING WEIGHT OF KIT
	R#31	P. IV-27	SHIPPING WEIGHT OF KIT
	R#32	P. IV-28	COMPLEXITY FACTOR FOR WIRING CHANGE, SHIPPING WEIGHT OF KIT
	R#33	P. IV-28	COMPLEXITY FACTOR FOR WIRING CHANGE, SHIPPING WEIGHT OF KIT

Exhibit IV-1. AIRCRAFT/AVIONICS MODIFICATION COST MODEL REFERENCE MATRIX (CONT'D)

GENERAL (BOX INSTALLATIONS/REMOVALS AND BOX MODIFICATIONS)			
DEPENDENT VARIABLE	REFERENCE	PAGE #	INDEPENDENT VARIABLE (S)
NON-RECURRING $	NON-RECURRING ELEMENT TABLE	P. IV-8	TOTAL NON-RECURRING COST
MODIFICATION LABOR $	R#18	P. IV-19	SHIPPING DIMENSIONS OF KIT
	R#19	P. IV-20	SHIPPING DIMENSIONS OF KIT
	R#20	P. IV-20	KIT CUM AVE COST
	R#21	P. IV-21	KIT CUM AVE COST
	R#22	P. IV-21	KIT CUM AVE COST
MODIFICATION MANHOURS	R#34	P. IV-28	HARWARE CUM AVE COST
	R#35	P. IV-29	HARDWARE CUM AVE COST,NO. OF UNITS (COMPONENTS) INSTALLED AND REMOVED
	R#36	P. IV-29	TECHNICAL DIRECTIVE PREPARATION COST, SHIPPING WEIGHT OF KIT

Exhibit IV-1. AIRCRAFT/AVIONICS MODIFICATION COST MODEL REFERENCE MATRIX (CONT'D) and ILS. These are independent of the items procured. In addition to the CERs derived for total non-recurring costs, a represen-tative breakout of the non-recurring cost elements was developed, shown in Exhibit IV-2. The sub-elements were included in calculation of average percent of total non-recurring only when there was a positive value for the sub-element. As there were not costs for each sub-element in the matrix, the calculated percentages did not total 100 percent. Therefore, the percentages were adjusted to total 100 percent, providing a representative breakout for estimating. The breakout reflects estimated percent of elements to total non-recurring cost, assuming all non-recurring sub-elements are expected to be present.

<u>Reference No. 1</u>

<u>Non-recurring costs (box installations/removals)</u>

nonrec = 615.4 (box_ins)

Where: nonrec = Non-recurring costs in FY84 $K
box_ins = No. of black-boxes installed

and: Sample size = 11
R^2(adj.) = .6547
SEE = 608
Mean = 822.72
Range = nonrec: 8 to 3071,
box_ins: 1 to 3

This CER applies to total non-recurring costs for installations and removals of avionics and missile systems only. These are generally implemented by airframe changes (AFCs). This relationship does not apply to avionics system modifications.

NON-RECURRING 84$K	ENG DEV/ DESIGN/ TEST 84$K	NRE 84$K	TOOLING 84$K	TEST 84$K	TD TOT 84$K	TECH. DIR. PREP 84$K	TECH. DIR. P&P 84$K	DRAWINGS 84$K	DATA/ PUBS TOT 84$K	DATA/ PUBLI- CATIONS 84$K	PUBS PRINTING 84$K	ILS 84$K
3071	2681	1823	175	683	10.38	10	0.38	0	151.62			228
1572	1111	1005	23	83	0	0	0	0	338	338	0	123
1055	608			57	234	233.4	0.6	0	213	192	21	0
1021.9	690.9				110.5	110.1	0.4		220.5	199	21.5	0
921	921	921	0	0	0	0	0	0	0	0	0	0
800	694.7			234	40.3	40	0.3	0	65	58.2	6.8	0
657	229	195	34	0	0	0	0	0	428	428	0	0
459.25	58	24.2	0	33.8	45.45	45.4	0.05	86	269.8	235	34.8	0
379.23	312.4				5.23	4.7	0.53	0	61.6	56	5.6	0
301	145.3				76.3	75.9	0.4	0				
205.4	160.4				9	8.5	0.5	12.7	23.3	21.2	2.1	0
155	94.9				4.1	3.4	0.7	0	56	56	0	0
72	18.2	18.2	0	0	1.8	1.4	0.4	0	52	43.3	8.7	0
34	34	34	0	0	0	0	0	0	0	0	0	0
25.61	17.3				2.81	2.8	0.01	0	5.5	5	0.5	0
16.4	2.1				10.8	9.5	1.3	0	3.5	3.1	0.4	0
8	8	8	0	0	0	0	0	0	0	0	0	0

	NON-RECURRING	ENG DEV/ DESIGN/ TEST	NRE	TOOLING	TEST	TD TOT	TECH. DIR. PREP	TECH. DIR. P&P	DRAWINGS	DATA/ PUBS TOT	DATA/ PUBLI- CATIONS	PUBS PRINTING	ILS
Cost Element as % of Total Non-recurring		72.4%	59.3%	4.4%	15.7%	7.3%	7.2%	0.1%	14.8%	19.9%	25.5%	2.5%	7.6
Cost Element as % of Total Non-recurring Normalized to 100%	100.00%	59.4%	44.4%	3.3%	11.7%	6.0%	5.9%	0.1%	12.1%	16.3%	14.8%	1.5%	6.2

Note Non-recurring cost elements may not add to total where values for all of the elements are not known.

Exhibit IV-2. REPRESENTATIVE NON-RECURRING COST ELEMENT BREAKOUT

Although the R^2 value is not high, the CER is useful because the input parameter should be known early on in the modification planning.

Reference No.2

Non-recurring costs (box installations/removals)

nonrec = 1.40 (twt_ins) + 524.7

Where: nonrec = Non-recurring costs in FY84 $K
twt_ins = total weight installed

and: Sample size = 7
R^2(adj.) = .6939
SEE = 235
Mean = 837.84
Range = nonrec: 301 to 1571
twt_ins: 24 to 761

This CER applies to non-recurring costs for installations and removal of black-boxes only. The total weight installed includes the weight of the units, the miscellaneous hardware (brackets, etc.), and cables installed. Installations identified as form-fit-function replacements were excluded from the data set, as they lowered the quality of the regression statistics, and would logically be expected to have different non-recurring costs. Although this total weight to be installed may not be known at the outset of the modification planning, it may become available as the planning progresses.

Reference No. 3

Non-recurring costs (box installations/removals)

nonrec = $22.2\ (\text{box\_ins})^{2.34}\ (\text{wirch}+1)^{1.98}$

Where: nonrec = Non-recurring costs in FY84 $K
box_ins = No. of black-boxes installed
wirch = Complexity factor for wiring change

and: Sample size = 11
R^2(adj.) = .5444
SEE = 1.2 (+239 percent, -70 percent)
Mean = 822.7
Range = nonrec: 8 to 3071
wirch: 0 to 3
box_ins: 1 to 3

This CER applies to non-recurring costs for installations and removals of black-boxes only. Although the R^2 is not high, the input parameters should be known early-on in the modification planning. The categories used to define wiring complexity are shown in Appendix C.

<u>Reference No. 4</u>

<u>Non-recurring costs (F-F-F box installations/removals)</u>

nonrec = 12.94 (mhrs_100)

Where: nonrec = Non-recurring costs in FY84 $K
mhrs_100 = manhours to install at unit 100

and: Sample size = 4
R^2(adj.) = .9993
SEE = 55
Mean = 487
Range = nonrec: 14 to 1884
mhrs_100: 1.14 to 237

This CER applies to form-fit-function black-box installations and removals only. Although the input parameter may not be available early-on, estimates of its value may be.

<u>Reference No. 5</u>

<u>Non-recurring costs (box modifications)</u>

nonrec = .9702(kit_cac) + 187.9

Where: nonrec = Non-recurring costs in FY84 $K
kit_cac = Kit cum. ave. cost at unit 100 in FY84 $K

and: Sample size = 5
R^2(adj.) = .8346
SEE = 142
Mean = 337.1
Range = nonrec: 25.5 to 921
kit_cac: .1 to 758

This CER applies to black-box modifications only. Although the input parameter may not be known early-on in the modification planning, it may become available, or may be estimated.

Reference No. 6

Non-recurring costs (box modifications)

nonrec = 137.8 + .98 (mhrs_est)

Where: nonrec = Non-recurring costs in FY84 $K
mhrs_est = Estimated installation manhours

and: Sample size = 6
R^2(adj.) = .8072
SEE = 149
Mean = 283.7
Range = nonrec: 16.4 to 921
mhrs_est: 5 to 800

This CER is for estimation of box modification non-recurring costs. The estimated manhours parameter comes from the expected manhours to install reflected in the Technical Directive. This estimate is generally higher than the reported installation manhours. This parameter may not be known early-on, but will eventually be available from the Technical Directive.

B. INSTALLATION KIT COSTS

Installation kit costs include the recurring costs of manufacture and assembly of the retrofit kits for the system or equipment affected by the modification. The prototype kit used by the manufacturer for "validation" through installation in an operating aircraft and the first production kit used by the NARF for "verification", also in an operating aircraft, are include in the data base from which the CER was derived. The GFE or CF black-box systems to be installed are not included with the kits

The learning curve reflected for kit costs in the OSIP dat was derived during the last effort. This was an average learnin curve slope of 98.5 percent (b = -.0218). To adjust th recurring kit costs obtained from the following CERs to quantities other than 100, the following formula should be used:

$$kit\_cac_Q = kit\_cac_{100} \times 1.105 \times Q^{-.0218}$$

Where: kit_cac_Q = Kit cum. ave. cost for the quantit desired
kit_cac_{100} = Kit cum. ave. cost obtained fro the CERs
Q = Quantity of kits being estimated

Reference No. 7

Installation kit costs (box installations/removals)

$$kit\_cac = .01\ (hw\_cac)^{1.013}\ (un\_inst)^{1.596}$$

Where: kit_cac = Kit cum. ave. cost at unit 100 in FY8 $K
hw_cac = Cum. ave. cost of hardware at unit 10 in FY84 $K
un_inst = Number of units (components) installed

and: Sample size = 12
R^2(adj.) = .8176
SEE = .72 (+105 percent, -51 percent)
Mean = 37.52
Range = kit_cac: .8 to 133
hw_cac: 19 to 262
un_inst: 3 to 14

This CER estimates the recurring installation kit costs fc installations and removals only. The CER is useful because i utilizes parameters that should be available early on in th program.

Reference No. 8

Installation kit costs (box installations/removals)

$$kit\_cac = (hw\_cac)^{.8304}$$

Where: kit_cac = Kit cum. ave. cost at unit 100 in FY84 $K
hw_cac = Hardware cum. ave. cost at unit 100 in FY84 $K

and: Sample size = 7
R_2(adj.) = .7499
SEE = 0.42 (+52 percent, -34 percent)
Mean =61
Range = kit_cac: 10 to 133
hw_cac: 17 to 262

This CER estimates the recurring installation kit costs for box installations/removals. The data set was limited to cases where the kit cost exceeds $10,000 as it was assumed that kits in this cost range are of more interest to the estimator. Limiting the data set also increased the R^2 of the equation.

Reference No. 9

Installation kit costs (box installations/removals)

$$kit\_cac = (hw\_cac)^{.6560}$$

Where: kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K

and: Sample size = 13
R^2(adj.) = .4810
SEE = 1.23 (+242 percent, -.71 percent)
Mean =35.4
Range = kit_cac: .8 to 133
hw_cac: 17 to 262

This CER also estimates the recurring installation kit costs for box installations/removals. This CER includes all data points, unlike the previous CER (Reference No. 8). The R^2 deteriorates with all data points included. However, the equation utilizes a parameter which should be available early on in modification planning.

Reference No. 10

Installation kit costs (box installations/removals)

kit_cac = .0619 (hw_cac) + .0012(kit_dims)

Where: kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
kit_dims = Shipping dimensions of kit (inches^3)

and: Sample size: = 8
R^2(adj.) = .8927
SEE = 12
Mean = 24.31
Range = kit_cac: .8 to 117
hw_cac: 19 to 159
kit_dims: 64 to 82944

This CER estimates recurring installation kit costs for box installations/removals. The R^2 is relatively high, but the kit dimension parameter may not be readily available early on.

Reference No.11

Installation kit costs (box installations/removals)

kit_cac = .0670(hw_cac) + .3939(kit_wt)

Where: kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
kit_wt = Shipping weight of kit (pounds)

and: Sample size = 12
R^2(adj.) = .8839
SEE = 16
Mean = 34.1
Range = kit_cac: .8 to 133
hw_cac: 17 to 262
kit_wt: 1 to 250

This CER estimates the installation kit cost for box installations/removals. As in the previous CER (Reference No.

10), the kit weight parameter may not be readily attainable early on. However, the equation offers a good R^2, if the information is available.

Reference No. 12

Modification kit costs (box modifications)

kit_cac = 2.111(uwt_ins) + 4.721(wir_chge)

Where: kit_cac = Kit cum. ave. cost at unit 100 in FY84 $K
uwt_ins = Weight (pounds) of units (components) installed
wir_chge = Complexity factor for wiring change

and: Sample size = 12
R^2(adj.) = .7549
SEE = 109
Mean = 81.41
Range = kit_cac: .1 to 758
uwt_ins: 0 to 273
wir_chge: 1 to 4

This CER estimates the recurring modification kit cost for box modifications. The data set includes modifications where there were either unit weight installed into the system, or a wiring change to the system, or both. Categories used to define the wiring changes are provided in Appendix C.

Reference No. 13

Modification kit costs (box modifications)

kit_cac = 1.38(uwt_ins) + .7746(kit_wt)

Where: kit_cac = kit cum. ave. cost at unit 100 in FY84 $K
uwt_ins = Weight of units (components) installed
kit_wt = Shipping weight of modification kit

and: Sample size = 19
R^2(adj.) = .7715
SEE = 83
Mean = 67.15
Range = kit_cac: .1 to 758
uwt_ins: 0 to 273
kit_wt: .25 to 350

This CER applies to black-box modifications only. The R^2 is relatively good, however the relationship utilizes parameters (weight of units installed and shipping weight of kit) not available early on.

C. MODIFICATION LABOR COSTS

Modification labor costs include costs for modification of systems or equipment by depot rework, depot field team, commercial rework or commercial field team. Organizational and intermediate level installations do not reflect costs in the OSIP data. Costs include all labor-related costs for retrofit, testing and TD verification. The modification labor costs are funded under O&MN. Modification labor costs for trainers should be accounted for as a separate item on the OSIP, and it is not included in the following CERs.

The installation costs in the past-year OSIP data reflected negligible learning. The reason may be that the modifications are funded up-front, and the necessary funding for the installation is not constantly revised to reflect the actual learning (reflected in the reported installation manhours). The funding is based on "product-standard manhours" for each type of modification, and they are revised only sporadically to reflect the experienced actual installation labor hours. Also, the OSIP installation costs may include some costs which are necessary during the retrofit, but not directly related to the retrofit, such as standardizing aircraft configurations, repair of repairables, etc. Therefore, although the following CERs reflect the "historical" price of installations, as reflected in the OSIP data, they may not accurately reflect a consistent relationship to the reported installation manhours.

There was more data available in the data base to derive relationships for the installation manhours than for the installation cost. Also, as the installation manhours may be more reflective of the actual resources required for the installation, it may be preferable to utilize the installation manhour CERs in projecting expected installation labor requirements.

Reference No. 14

Modification labor costs (box installations/removals)

inst_cac = .0014 (kit_dims)

Where: inst_cac = Cum. ave. cost of installation labor at unit 100 in FY84 $K
kit_dims = Shipping dimensions of kit (inches^3)

and: Sample size = 10
R^2(adj.) = .8605
SEE = 26
Mean = 40.93
Range = inst_cac: .9 to 235
kit_dims: 512 to 138240

This CER estimates installation labor costs for box installations/removals. Although the relationship includes a parameter not available early on, this CER was among the few statistically valid relationships that could be derived for this cost element.

Reference No. 15

Modification labor costs (box installations/removals)

inst_cac = 4.68 + .2537 (kit_cac)

Where: inst_cac = Cum. ave. cost of installation labor at unit 100 in FY84 $K
kit_cac = Cum. ave. cost of installation kit at unit 100 in FY84 $K

and: Sample size = 6
R^2(adj.) = .9112
SEE = 6
Mean = 36.75
Range = inst_cac: .57 to 55.1
kit_cac: .8 to 199.6

This CER estimates the installation labor cost for box installations/removals only. Although the kit cost parameter may not be available, it can be estimated using one of the relationships provided in this model.

Reference No. 16

Modification labor costs (box modifications)

inst_cac = .4958 (uin/mod) + .2772(twt_ins)

Where: inst_cac = Cum. ave. cost of installation labor in FY84 $K
uin/mod = Number of units installed plus modified
twt_ins = total weight installed into the system

and: Sample size = 9
R^2(adj.) = .7412
SEE = 2
Mean = 2.94
Range = inst_cac: .4 to 14.6
uin/mod: 1 to 4
twt_inst: 0 to 38.1

This CER estimates the modification labor costs for black-box modifications only. It applies to basic kit installations only, and does not apply to trainer, spares or PSE installations.

Reference No. 17

Modification labor costs (box modifications)

$$inst\_cac = (kit\_cac)^{1.038}$$

Where: inst_cac = Cum. ave. cost of installation labor at unit 100 in FY84 \$K
kit_cac = Cum. ave. cost of kit at unit 100 in FY84 \$K

and: Sample size = 4
R^2(adj.) = .4228
SEE = 0.71 (+102 percent, -51 percent)
Mean = 8.52
Range = inst_cac: 3.4 to 14.6
kit_cac: 2.1 to 12.9

This CER applies to box modifications only. The input parameter, kit cost, may be estimated by relationships contained in this model.

Reference No. 18

Modification labor costs (general)

$$inst\_cac = .0255\ (kit\_dims)^{.6537}$$

Where: inst_cac = Cum. ave. cost of installation labor at unit 100 in FY84 \$K
kit_dims = Shipping dimensions of kit (inches^3)

and: Sample size = 19
R^2(adj.) = .6830
SEE = .98 (+166 percent, -62 percent)
Mean = 21.35
Range = inst_cac: .4 to 235
kit_dims: 64 to 138240

This CER was derived using data points for both box installation/removals and box modifications. The input parameter may not be available, initially, but may become available as the program progresses.

Reference No. 19

Modification labor costs (general)

inst_cac = .0014 (kit_dims)

Where: inst_cac = Cum. ave. cost of modification labor at unit 100 in FY84 $K
kit_dims = Shipping dimensions of kit (inches^3)

and: Sample size = 19
R^2(adj.) = .8711
SEE = 19
Mean = 21.35
Range = inst_cac: .4 to 235
kit_dims: 64 to 138240

This CER is for modification labor costs for both box installations/removals and box modifications. Although the input parameter, kit dimensions, may be difficult to obtain, the R^2 is relatively high.

Reference No. 20

Modification labor costs (general)

inst_cac = .2524 (kit_cac) + 5.72

Where: inst_cac = Cum. ave. cost of modification labor at unit 100 in FY84 $K
kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K

and: Sample size = 11
R^2(adj.) = .8255
SEE = 7
Mean = 126.64
Range = inst_cac: .57 to 55.1
kit_cac: .8 to 199.6

This CER is for modification labor costs for both box installations/removals and box modifications. Although the input parameter, kit cost, may not be known early on, it may become available or may be estimated from a relationship within this model.

Reference No. 21

Modification labor costs (general)

$$inst\_cac = (kit\_cac)^{.9049}$$

Where: inst_cac = Cum. ave. cost of modification labor at unit 100 in FY84 $K
kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K

and: Sample size = 10
R^2(adj.) = .7586
SEE = 0.68 (+98 percent, -50 percent)
Mean = 12.56
Range = inst_cac: .57 to 55.1
kit_cac: .8 to 199.6

This CER estimates modification labor for both box installations/removals and box modifications. The limitation of the relationship is that there must be a positive kit cost to perform the estimate. The data set used for the regression includes one outlier, which was excluded in deriving the following relationship.

Reference No. 22

Modification labor costs (general)

$$inst\_cac = (kit\_cac)^{1.064}$$

Where: inst_cac = Cum. ave. cost of modification labor at unit 100 in FY84 $K
kit_cac = Cum. ave. cost of kit at unit 100 in FY84 $K

and: Sample size = 9
R^2(adj.) = .7601
SEE = 0.61 (+83 percent, -45 percent
Mean = 7.8
Range = inst_cac: .57 to 21.2
kit_cac: .8 to 12.9

This CER is the same as the previous one, except the outlier kit cost was excluded from the data set. It is used to estimate modification labor costs for both box installations/removals and box modifications. The limitation for its use is that there must be a positive kit cost input parameter. (Some form-fit-function modifications reflected no kit cost).

D. MODIFICATION MANHOURS

The following analysis was performed using the manhours to perform modifications, as reported in the TDSA. The modification manhours were all normalized to unit 100, as discussed in Section II, Part C, Data Normalization. In order to translate the manhour estimates into modification labor costs, a labor rate is required. Sources at NAVAIR indicated that the labor rate can vary dramatically depending on current policies in effect, region of the installing activity, and particular contractor. It is suggested that the relevant labor rate to be expected for the particular installer be applied to the following estimates.

However, in order to provide an estimated labor rate if actual rates are unavailable, the following was performed. Installation labor costs in the OSIP are funded up-front, based on the estimated modification manhours. Therefore, the relationship between estimated manhours and installation cost provides an estimated labor rate. The relationship derived indicated an average of 64$/manhour for modifications and 108$/hour for installation/removals.

Analysis was performed to compare the actual reported manhours from TDSA, normalized to unit 100, with the estimated manhours shown on the Technical Directive and in TDSA. The calculated average of reported (at unit 100) to estimated manhours was 79 percent, based on 74 data points. (Four data points were removed from the sample because calculated percentages of <10 percent or >400 percent indicated that there may be a reporting error in the data.) The average for box installations/removals was the same as that for box modifications.

The modification manhours include labor for retrofit, testing, and technical directive verification for the change.

Reference No. 23

Modification manhours (box installations/removals)

mhrs_100 = .7810 (hw_cac) + .0689 (aveq_wt)

Where: mhrs_100 = Modification manhours at unit 100
hw_cac = Hardware Cum. ave. cost at unit 100 in FY84 $K
aveq_wt = Weight of avionics equipment already installed in the aircraft.

and: Sample size = 13
R^2(adj.) = .8002
SEE = 130
Mean = 199.03
Range = mhrs_100: 1.14 to 817
hw_cac: 3.58 to 262
aveq_wt: 385 to 6542

This CER applies to cases where there are both box installation(s) and box removal(s). The equation utilizes input parameters which should be known early on.

Reference No. 24

Modification manhours (box installations/removals)

$$mhrs\_100 = .0046(uwt\_ins)^{.8005} (wir\_chge+1)^{5.529}$$

Where: mhrs_100 = Modification manhours at unit 100
uwt_ins = Weight of units installed (pounds)
wir_chge = Complexity of wiring change

and: Sample size = 17
R^2(adj.) = .7112
SEE = .88 (+141 percent, -59 percent)
Mean = 296.64
Range = mhrs_100: 8.08 to 817
uwt_ins: 8.95 to 531.6
wir_chge: 1 to 3

This CER estimates the manhours to perform box installa-ion(s) where there is also at least one box removed. It does not apply to form-fit-function replacements. The input parameters should be available early on in the program. Categories used to define wiring change complexity are provided in Appendix C.

Reference No. 25

Modification manhours (box installations/removals)

mhrs_100 = .6503 (hw_cac) + 1359 (cmplx)

Where: mhrs_100 = Modification manhours at unit 100
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
cmplx = Percentage of total weight installed and removed that is cabling

and: Sample size = 12
R^2(adj.) = .9486
SEE = 63
Mean = 209.89
Range = mhrs_100: 1.14 to 817
hw_cac: 19 to 262
cmplx: 0 to .49

This CER applies to cases where there are both box installation(s) and box removal(s). The equation uses input parameters that should be readily available.

Reference No. 26

Modification manhours (box installations/removals)

mhrs_100 = .7567 (hw_cac) + 4.165 (othin)

Where:
- mhrs_100 = Modification manhours at unit 100
- hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
- othin = Weight of miscellaneous hardware (brackets, etc.) plus cabling installed

and:
- Sample size = 12
- R^2(adj.) = .9400
- SEE = 66
- Mean = 209.85
- Range = mhrs_100: 1.14 to 817
  - hw_cac: = 19 to 262
  - othin: 0 to 168

This CER applies to cases where there are both box installation(s) and box removal(s). Although the R^2 is relatively high, the weight installed that is not part of the actual system may be difficult to obtain.

Reference No. 27

Modification manhours (box installations/removals)

mhrs_100 = .83(hw_cac) + 4.38(cabin) + .9237(cabrem)

Where:
- mhrs_100 = Modification manhours at unit 100
- hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
- cabin = Weight of cabling installed (pounds)
- cabrem = Weight of cabling removed (pounds)

and:
- Sample size = 12
- R^2(adj.) = .9313
- SEE = 74
- Mean = 209.85
- Range = mhrs_100: 1.14 to 817
  - hw_cac: 21 to 262
  - cabin: 0 to 117
  - cabrem: 0 to 339.6

This CER applies to cases where there are box(es) installed and removed. The equation implies that the modification manhours are directly related to the extent of the cabling change required.

Reference No. 28

Modification manhours (box installations/removals)

mhrs_100 = .8832(hw_cac) + .0008(kit_dims)

Where:
mhrs_100 = Modification manhours at unit 100
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
kit_dims = Shipping dimensions of kit (inches^3)

and:
Sample size = 9
R^2(adj.) = .8975
SEE = 74
Mean = 208.75
Range = mhrs_100: 1.14 to 817
hw_cac: 17 to 197
kit_dims: 64 to 82944

This CER applies to box installations/removals. The kit dimensions appear to be the main driver in the equation. The kit dimensions may not be available early on, but may become available as the program progresses.

Reference No. 29

Modification manhours (box installations/removals)

mhrs_100 = .1408 (hw_cac) + 2.353 (twt_ins)

Where:
mhrs_100 = Modification manhours at unit 100
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
twt_ins = Total weight installed into aircraft (regardless of weight removed)

and:
Sample size = 12
R^2(adj.) = .8570
SEE = 111
Mean = 209.85
Range = mhrs_100: 1.14 to 817
hw_cac: 19 to 262
twt_ins: 20.7 to 311.4

This CER applies to cases where there are box installations and removals. The total weight installed includes the system hardware installed, plus miscellaneous hardware and cabling.

Reference No. 30

Modification manhours (box modifications)

mhrs_100 = .9743 (kit_wt)

Where: mhrs_100 = Modification manhours at unit 100
kit_wt = Shipping weight of kit (pounds)

and: Sample size = 35
R^2(adj.) = .7142
SEE = 110
Mean = 70.52
Range = mhrs_100: .86 to 1160.97
kit_wt: .25 to 1000

This CER applies to box (system) modifications only. Although the kit weight may be difficult to obtain early on, it was found to be the only significant cost driver for box modifications. The data set includes all data points.

Reference No. 31

Modification manhours (box modifications)

mhrs_100 = 1.025 (kit_wt)

Where: mhrs_100 = Modification manhours at unit 100
kit_wt = Shipping weight of kit (pounds)

and: Sample size = 13
R^2(adj.) = .7078
SEE = 170
Mean = 182.61
Range = mhrs_100: 10.14 to 1160.97
kit_wt: .25 to 1000

This CER is the same as the previous CER, except that only those data points with modification manhours greater than 10 were included. This relationship applies to box modifications only.

Reference No. 32

Modification manhours (box modifications)

mhrs_100 = 32.1 (wir_chge) + .8262 (kit_wt)

Where: mhrs_100 = Modification manhours at unit 100
wir_chge = Complexity of wire change
kit_wt = Shipping weight of kit

and: Sample size = 32
R^2(adj.) = .7410
SEE = 110
Mean = 60.82
Range = mhrs_100: .86 to 1160.97
wir_chge: 0 to 4
kit_wt: .6 to 1000

This CER applies to box modifications only.

Reference No. 33

Modification manhours (box modifications)

mhrs_100 = 40 (wir_chge) + .8413 (kit_wt)

Where: mhrs_100 = Modification manhours at unit 100
wir_chge = Complexity of wire change
kit_wt = Shipping weight of kit (pounds)

and: Sample size = 12
R^2(adj.) = .7063
SEE = 171
Mean = 198.44
Range = mhrs_100: 10.14 to 1160.97
wir_chge: 1 to 4
kit_wt: .5 to 1000

This CER applies to box modifications only. It uses the same parameters as the preceding relationship, however the data set was limited to those cases where the manhours exceeded 10.

Reference No. 34

Modification manhours (general)

mhrs_100 = 2.738 (hw_cac)

Where: mhrs_100 = Modification manhours at unit 100
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K

and: Sample size = 14
R^2(adj.) = .6036
SEE = 2162
Mean = 194.05
Range = mhrs_100: 1.14 to 817
hw_cac: 1.1 to 262

This CER applies to all cases. It was derived using box installation/removal and box modification data points. Although the R^2 is not high, it was listed because the input parameter should be available early on.

Reference No. 35

Modification manhours (general)

mhrs_100 = 1.928 (hw_cac) + 8.085 (unin+rem)

Where: mhrs_100 = Modification manhours at unit 100
hw_cac = Cum. ave. cost of hardware at unit 100 in FY84 $K
unin+rem = Number of units installed plus removed

and: Sample size = 12
R^2(adj.) = .7047
SEE = 168
Mean = 208.47
Range = mhrs_100: 1.7 to 817
hw_cac: 1.1 to 262
unin+rem: 4 to 26

This CER applies to cases where units are both installed and removed. The data set used to derive the relationship included only those data points where there were units both installed and removed, and there were no units modified.

Reference No. 36

Modification manhours (general)

mhrs_100 = 1.946 (td_prep) + 1.388 (kit_wt)

Where: mhrs_100 = Modification manhours at unit 100
td_prep = Cost of non-recurring technical directive preparation in FY84 $K
kit_wt = Shipping weight of kit (pounds)

and:

Sample size = 11
R^2(adj.) = .9060
SEE = 70
Mean = 149.14
Range = mhrs_100: 4.08 to 817
td_prep: 3.4 to 233.4
kit_wt: 3 to 250

This CER applies to all cases. It was derived using data points of both box installations/removals and box modifications.

APPENDIX A

CER DOCUMENTATION

Appendix A contains the documentation for the CERs included in the model discussed in Section IV. The reference number indicated at the top right-hand side of each page corresponds to the CERs, as numbered in the model. The order of the documentation is as follows:

- Descriptive Statistics;
- Residual Plot;
- Standard Plot of Fitted versus Actual Values;
- Data Set; and
- Graph of Independent versus Dependent Values (for single variable, linear relationships), or Actual versus Fitted Values (for several variables or exponential equations).

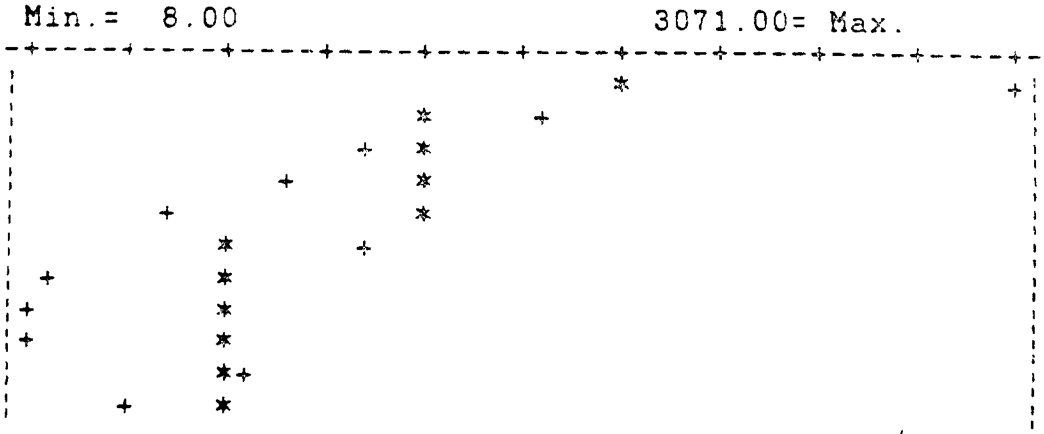
Ref.

```
                    OLS  -- DEPENDENT VARIABLE: nonrec

 RIGHT-HAND          ESTIMATED         STANDARD          T_STATISTIC      PR
  VARIABLE          COEFFICIENT          ERROR

 box_ins           615.383870968    (     109.19212)     T=     5.63579     0.

MPLE SIZE(   1 to    11) =             11          (DF=10)
M OF SQUARED RESIDUALS =         3696105.041935
         VARIANCE (MSE) =          369610.504194
NDARD ERROR (ROOT MSE) =             607.956005
              R-SQUARED =               0.686096
     ADJUSTED R-SQUARED =               0.654706
-STATISTIC(   1,     10) =             31.762129  (p=0.0002)
       SUM OF RESIDUALS =           -1411.625806
JRBIN-WATSON STATISTIC =               1.101383

                        Source  |  SUM SQ      |  DF  |  MEAN SQ
                  ------------------|-------------|------|------------|
                  |Due to Regression |   1.544E+007|     1|  1.544E+007|
                  |         Residual |   3.696E+006|    10|  3.696E+005|
                  |            Total |   1.913E+007|    11|  1.739E+006|
                  |------------------|-------------|------|------------|
                                                                        [E



                          Residual Plot

 Residual  Min.=-771.77      Mean=-128.33    1224.85= Max.
      (*)  -+----+----+----+M--0+----+----+----+----+----+-
 1  1224.85 |                    .                           *|
 2   340.23 |                    .        *                   |
 3  -175.77 |                 *  .                            |
 4  -430.77 |           *        .                            |
 5  -771.77 |*                   .                            |
 6   406.52 |                    .          *                 |
 7  -543.38 |        *           .                            |
 8  -581.38 |       *            .                            |
 9  -607.38 |      *             .                            |
 0    41.62 |                    .*                           |
 1  -314.38 |             *      .                            |
```

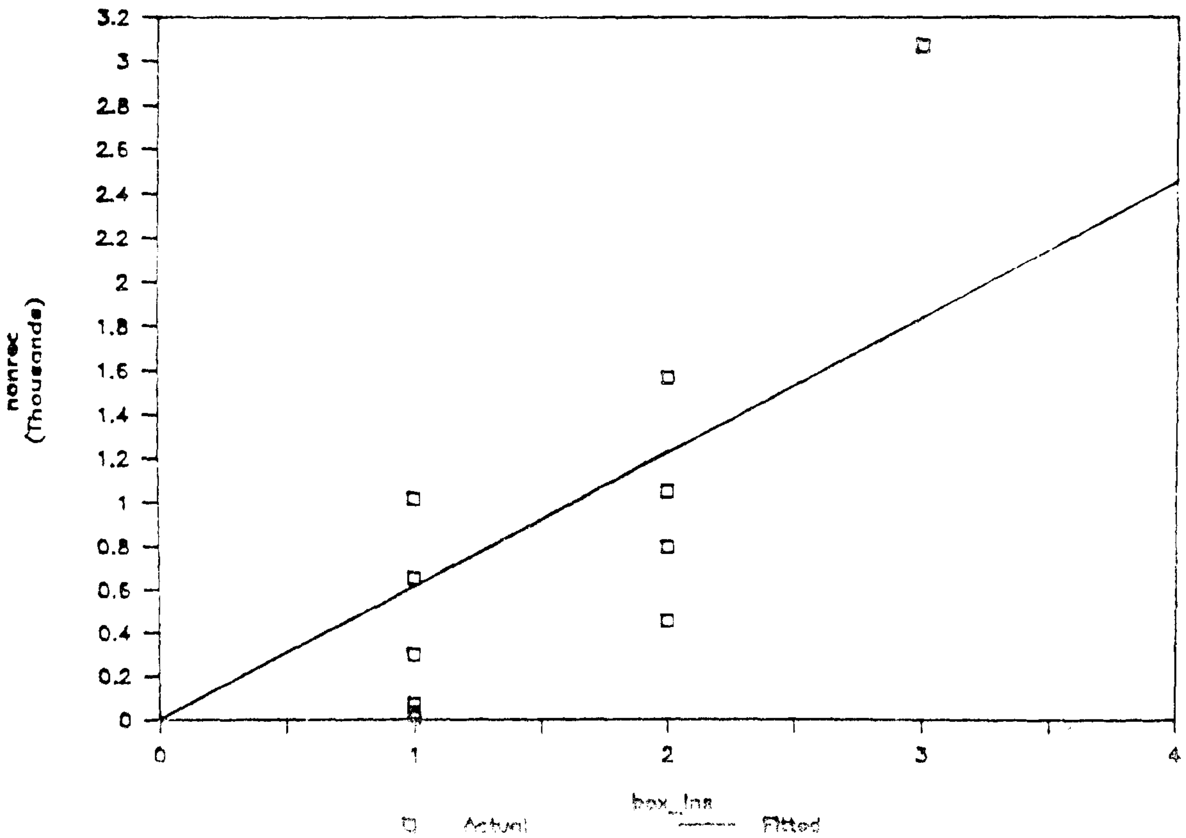
Ref. #1

Standard Plot

seq.	Fitted (*)	nonrec (+)
1	1846.15	3071.00
2	1230.77	1571.00
3	1230.77	1055.00
4	1230.77	800.00
5	1230.77	459.00
6	615.38	1021.90
7	615.38	72.00
8	615.38	34.00
9	615.38	8.00
10	615.38	657.00
11	615.38	301.00



osnum	osyr	box_ins	nonrec	Fitted	Residual
26.00	79.00	3.00	3071.00	1846.15	1224.85
104.00	79.00	2.00	1571.00	1230.77	340.23
47.00	81.00	2.00	1055.00	1230.77	-175.77
60.00	82.00	2.00	800.00	1230.77	-430.77
5.00	75.00	2.00	459.00	1230.77	-771.77
47.00	81.00	1.00	1021.90	615.38	406.52
5.00	75.00	1.00	72.00	615.38	-543.38
21.00	82.00	1.00	34.00	615.38	-581.38
6.00	83.00	1.00	8.00	615.38	-607.38
104.00	79.00	1.00	657.00	615.38	41.62
21.00	79.00	1.00	301.00	615.38	-314.38



Ref. #2

```
                      OLS  -- DEPENDENT VARIABLE:   nonrec

  RIGHT-HAND            ESTIMATED         STANDARD           T_STATISTIC        PROB.
   VARIABLE            COEFFICIENT         ERROR

 1  twt_ins           1.398150815   (       0.36588)    T=       3.82133       0.012
 2  Constant        524.697021713   (     120.90544)    T=       4.33973       0.007

SAMPLE SIZE( 52 to   58) =           7          (DF=5)
SUM OF SQUARED RESIDUALS =      276599.562475
         VARIANCE (MSE) =        55319.912495
TANDARD ERROR (ROOT MSE) =          235.201855
              R-SQUARED =            0.744931
     ADJUSTED R-SQUARED =            0.693918
 F-STATISTIC(  1,     5) =          14.602562 (p=0.0281)
       SUM OF RESIDUALS =            0.000000
 DURBIN-WATSON STATISTIC =            1.911252

                                    Source |   SUM SQ     |  DF  |  MEAN SQ
                        ------------------|--------------|------|-------------
                        Due to Regression |   1.084E+006|     1|  1.084E+006|
                                  Residual |   2.766E+005|     5|   55319.912|
                                     Total |   1.361E+006|     6|  2.268E+005|
                        ------------------|--------------|------|-------------
                                                                                [END]
```

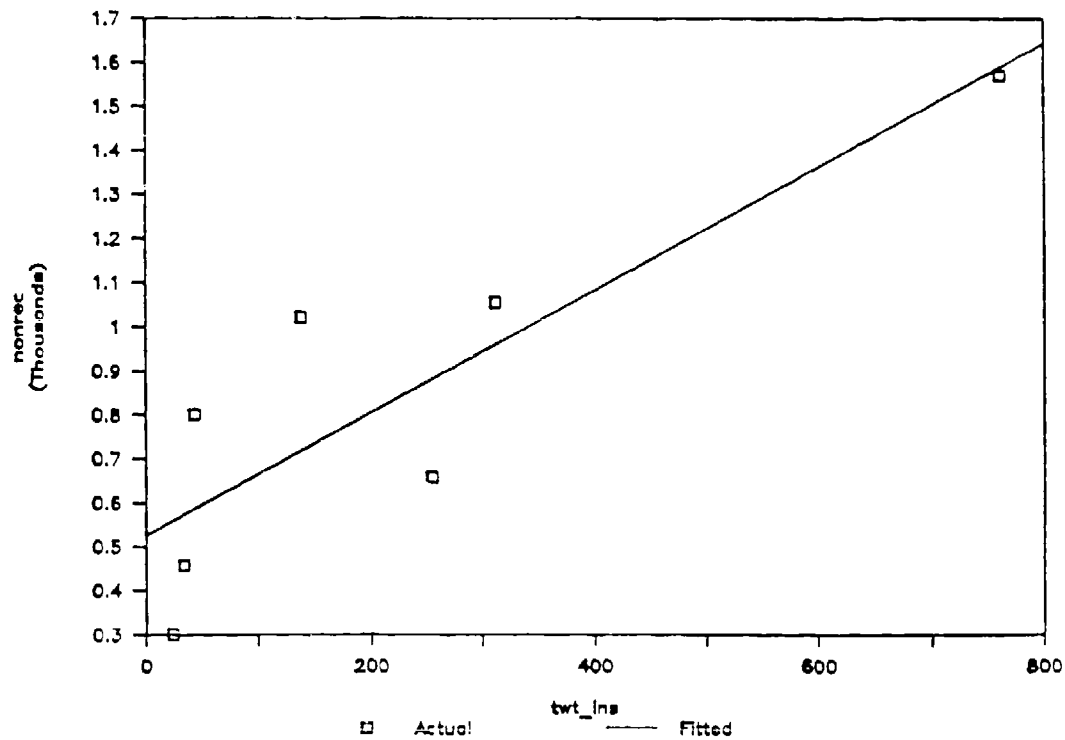
Residual Plot

```
eq.      x58    Min.=-257.25      Mean=0.00          304.12= Max.
         (*)  -+----+----+----+----+-M0-+----+----+----+----+----+-
 52    -18.39 |                     * .                              |
 53     94.92 |                       .        *                     |
 54   -223.53 |   *                   .                              |
 55    304.12 |                       .                             *|
 56    213.78 |                       .                  *           |
 57   -113.65 |            *          .                              |
 58   -257.25 |*                      .                              |
```

Standard Plot

```
seq.    Fitted    nonrec  Min.=301.00                       1589.39= Max.
          (*)       (+)  -+----+----+----+----+----+----+----+----+----+---+-
 52   1589.39   1571.00 |                                                 +*|
 53    960.08   1055.00 |                          *  +                     |
 54    880.53    657.00 |              +       *                            |
 55    717.78   1021.90 |                *           +                      |
 56    586.22    800.00 |           *       +                               |
 57    572.65    459.00 |      +    *                                       |
 58    558.25    301.00 |+         *                                        |
```

osnum	osyr	twt_ins	nonrec	Fitted	Residual
104.00	79.00	761.50	1571.00	1589.39	-18.39
47.00	81.00	311.40	1055.00	960.08	94.92
104.00	79.00	254.50	657.00	880.53	-223.53
47.00	81.00	138.10	1021.90	717.78	304.12
60.00	82.00	44.00	800.00	586.22	213.78
5.00	75.00	34.30	459.00	572.65	-113.65
21.00	79.00	24.00	301.00	558.25	-257.25



OLS -- DEPENDENT VARIABLE: NONREC

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 BOXIN	2.337614074	(0.95239)	T= 2.45448	0.040
2 WIRCH+1	1.975124028	(0.95498)	T= 2.06823	0.072
3 Constant	3.101858599	(0.96792)	T= 3.20465	0.013

```
SAMPLE SIZE( 46 to   56) =         11         (DF=8)
SUM OF SQUARED RESIDUALS =         11.926790
          VARIANCE (MSE) =          1.490849
STANDARD ERROR (ROOT MSE) =         1.221003
               R-SQUARED =          0.635493
      ADJUSTED R-SQUARED =          0.544366
 F-STATISTIC(  2,      8) =          6.973729 (p=0.0177)
       SUM OF RESIDUALS =          0.000000
 DURBIN-WATSON STATISTIC =          1.973227
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	32.720	2	16.360
Residual	11.927	8	1.491
Total	44.647	10	4.465

[END]

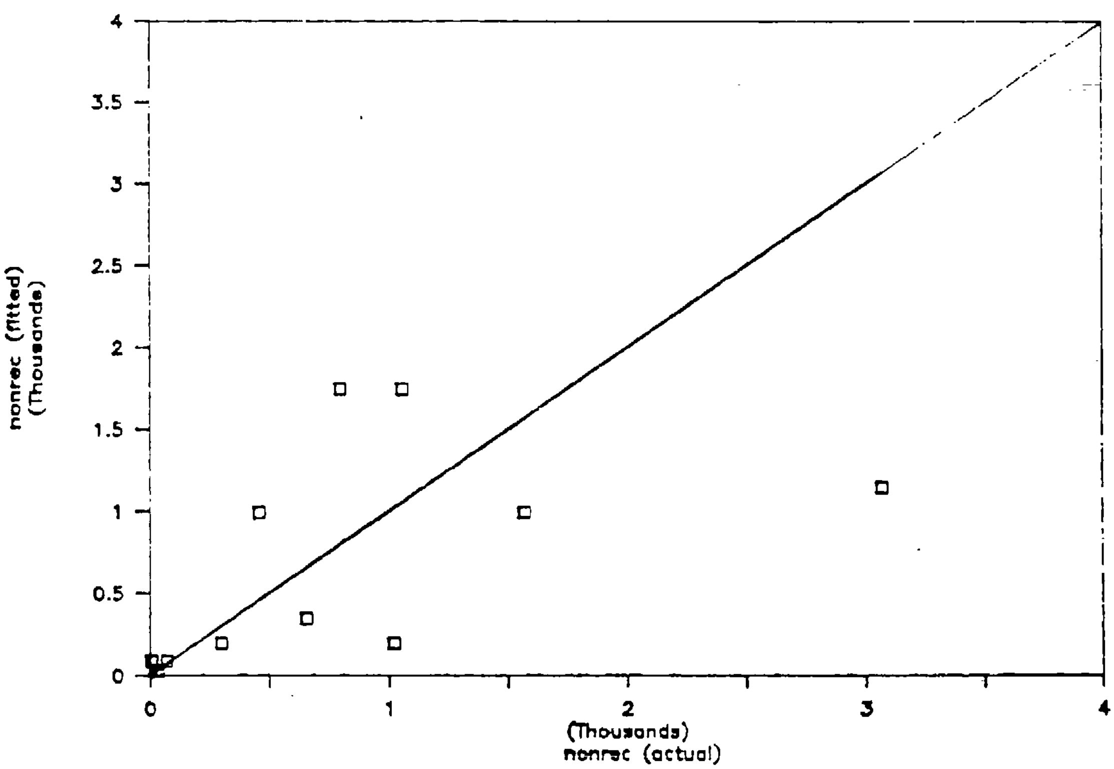
Standard Plot

```
seq. residual  Min.=-949.21      Mean=135.76      1925.87= Max.
          (*)  -+----+----+----+-0M-+----+----+----+----+----+-
 46  -694.21 |    *               .                              |
 47  -949.21 |*                   .                              |
 48  1925.87 |                    .                             *|
 49  -530.61 |       *            .                              |
 50   581.39 |                    .          *                   |
 51   311.51 |                    .    *                         |
 52   826.44 |                    .             *                |
 53   105.54 |                    .*                             |
 54   -79.58 |                  * .                              |
 55   -15.58 |                   *.                              |
 56    11.80 |                    *                              |
```

osnum	osyr	box_ins	wir_chge	nonrec	fitted	residual
47.00	81.00	2.00	3.00	1055.00	1749.21	-694.21
60.00	82.00	2.00	3.00	800.00	1749.21	-949.21
26.00	79.00	3.00	1.00	3071.00	1145.13	1925.87
5.00	75.00	2.00	2.00	459.00	989.61	-530.61
104.00	79.00	2.00	2.00	1571.00	989.61	581.39
104 00	79.00	1.00	3.00	657.00	345.49	311.51
47.00	81.00	1.00	2.00	1021.90	195.46	826.44
21.00	79.00	1.00	2.00	301.00	195.46	105.54
6.00	83.00	1.00	1.00	8.00	87.58	-79.58
5.00	75.00	1.00	1.00	72.00	87.58	-15.58
21.00	82.00	1.00	0.00	34.00	22.20	11.80

Standard Plot

```
seq.  nonrec   fitted Min.=  8.00                     3071.00= Max.
          (*)     (+) -+----+----+----+----+----+----+----+----+----+----+-
 46  1055.00  1749.21 |                 *          +                      |
 47   800.00  1749.21 |             *              +                      |
 48  3071.00  1145.13 |                   +                              *|
 49   459.00   989.61 |       *        +                                  |
 50  1571.00   989.61 |                +         *                        |
 51   657.00   345.49 |      +    *                                       |
 52  1021.90   195.46 |   +             *                                 |
 53   301.00   195.46 |   + *                                             |
 54     8.00    87.58 |*+                                                 |
 55    72.00    87.58 | @                                                 |
 56    34.00    22.20 |@                                                  |
```


4
3.5
3
2.5
2
1.5
1
0.5
0
nonrec (fitted)
(Thousands)
0
1
2
3
4
(Thousands)
nonrec (actual)

OLS -- DEPENDENT VARIABLE: nonrec

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PRO
1 mhrs_100	12.935112728	(0.23273)	T= 55.58013	0.0

```
SAMPLE SIZE( 1 to    4) =           4        (DF=3)
SUM OF SQUARED RESIDUALS =    9156.196034
          VARIANCE (MSE) =    3052.065345
STANDARD ERROR (ROOT MSE) =     55.245501
               R-SQUARED =      0.999303
      ADJUSTED R-SQUARED =      0.999071
   F-STATISTIC(  1,    3) =   3089.150375 (p=0.0000)
        SUM OF RESIDUALS =   -111.254777
  DURBIN-WATSON STATISTIC =      1.751852
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	9.437E+006	1	9.437E+006
Residual	9156.196	3	3052.065
Total	9.447E+006	4	2.362E+006

[EN

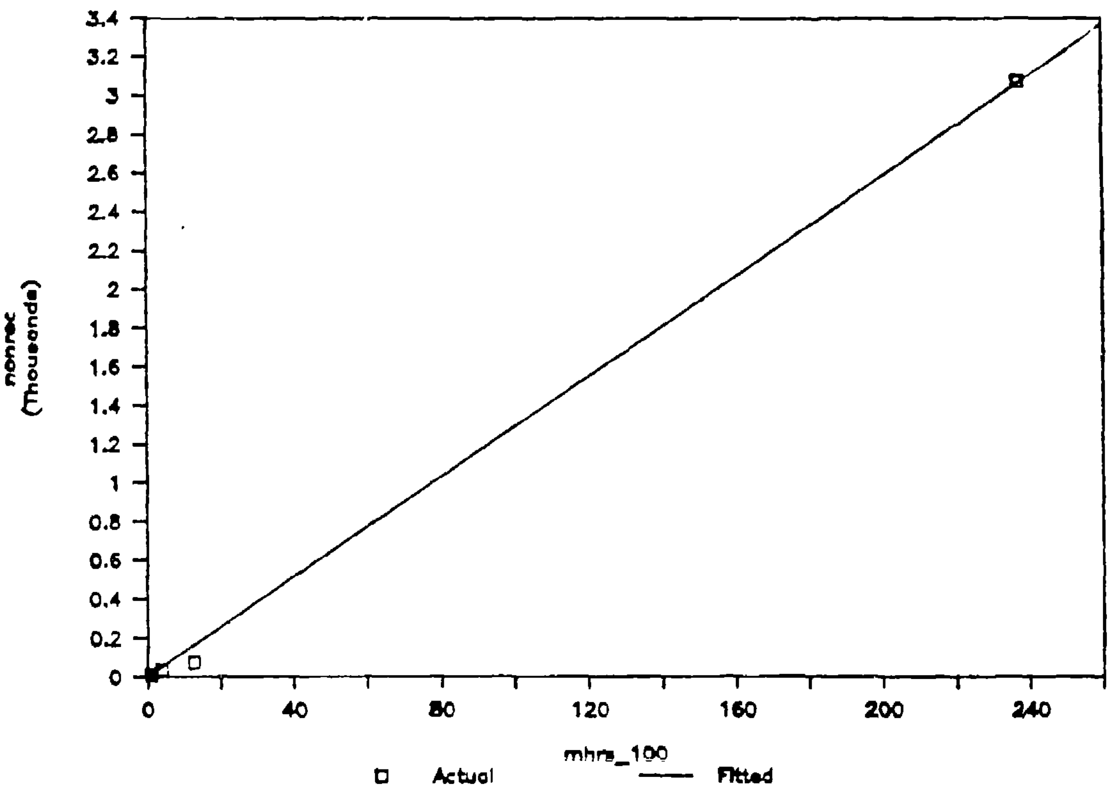
Residual Plot

```
seq.     x63   Min.=-93.96      Mean=-27.81      5.38= Max.
         (*)  -+----+----+----+----+----+----+--M-+----+----+-0--+-
   1    5.38  |                                                .  *|
   2  -93.96  |*                                               .   |
   3  -15.93  |                                        *       .   |
   4   -6.75  |                                            *   .   |
```

Standard Plot

```
 .    Fitted     nonrec   Min.=   8.00                                  3071.00= Max.
        (*)        (+)   -+----+----+----+----+----+----+----+----+----+----+-
1   3065.62    3071.00  |                                                       @|
2    165.96      72.00  |  +  *                                                 |
3     49.93      34.00  |+*                                                     |
4     14.75       8.00  |@                                                      |
```

osnum	osyr	mhrs_100	nonrec	Fitted	Residual
26.00	79.00	237.00	3071.00	3065.62	5.38
5.00	75.00	12.83	72.00	165.96	-93.96
21.00	82.00	3.86	34.00	49.93	-15.93
6.00	83.00	1.14	8.00	14.75	-6.75



Ref. #5

OLS -- DEPENDENT VARIABLE: nonrec

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 kit_cac	0.970224240	(0.21082)	T= 4.60207	0.019
2 Constant	187.898916305	(71.47265)	T= 2.62896	0.078

```
SAMPLE SIZE( 1 to     5) =            5         (DF=3)
SUM OF SQUARED RESIDUALS =     60858.808639
         VARIANCE (MSE) =      20286.269546
STANDARD ERROR (ROOT MSE) =      142.429876
              R-SQUARED =          0.875926
     ADJUSTED R-SQUARED =          0.834567
  F-STATISTIC(  1,    3) =        21.179024 (p=0.0193)
       SUM OF RESIDUALS =          0.000000
 DURBIN-WATSON STATISTIC =          1.312966
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	4.905E+005	1	4.905E+005
Residual	60858.809	3	20286.270
Total	5.514E+005	4	1.378E+005

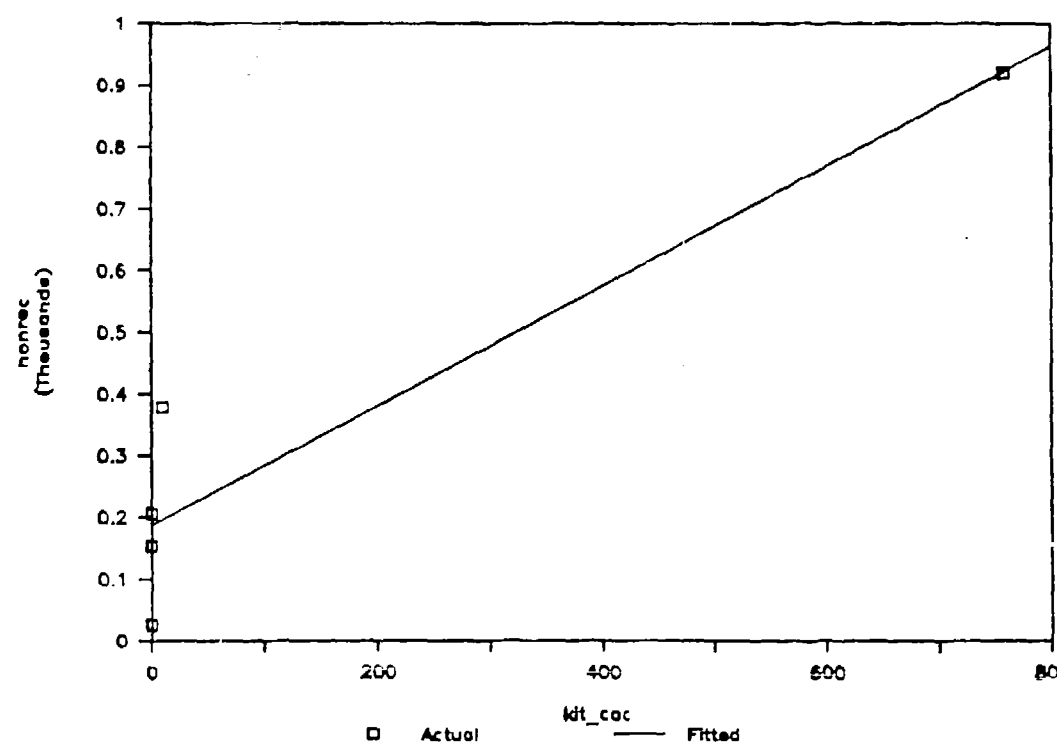
[END]

Residual Plot

```
seq.     x60    Min.=-162.50      Mean=0.00          181.59= Max.
         (*)  -+----+----+----+----+--M0+----+----+----+----+----+-
  1     -2.33 |                       *.                          |
  2    181.59 |                        .                         *|
  3     17.42 |                        . *                        |
  4    -34.19 |                   *    .                          |
  5   -162.50 |*                       .                          |
```

```
                               Standard Plot
seq.   Fitted   nonrec   Min.= 25.50                          923.33= Max.
        (*)      (+)    -+----+----+----+----+----+----+----+----+----+----+-
  1    923.33   921.00  |                                                  @|
  2    197.41   379.00  |          *          +                             |
  3    188.58   206.00  |         *+                                        |
  4    188.19   154.00  |       + *                                         |
  5    188.00    25.50  |+        *                                         |
```

osnum	osyr	kit_cac	nonrec	Fitted	Residual
49.00	82.00	758.00	921.00	923.33	-2.33
114.00	83.00	9.80	379.00	197.41	181.59
104.00	83.00	0.70	206.00	188.58	17.42
90.00	82.00	0.30	154.00	188.19	-34.19
47.00	81.00	0.10	25.50	188.00	-162.50



Ref. #6

```
                      OLS  -- DEPENDENT VARIABLE:   nonrec

  RIGHT-HAND           ESTIMATED        STANDARD          T_STATISTIC       PROB.
   VARIABLE           COEFFICIENT         ERROR

  1  mhrs_est          0.978236874   (      0.20885)    T=      4.68400      0.009
  2  Constant        137.843793940   (     68.34619)    T=      2.01685      0.114

 SAMPLE SIZE(  1 to     6) =            6        (DF=4)
 SUM OF SQUARED RESIDUALS =         88853.126869
           VARIANCE (MSE) =         22213.281717
STANDARD ERROR (ROOT MSE) =           149.041208
              R-SQUARED =               0.845797
      ADJUSTED R-SQUARED =              0.807246
  F-STATISTIC(  1,     4) =            21.939854 (p=0.0094)
       SUM OF RESIDUALS =               0.000000
  DURBIN-WATSON STATISTIC =             3.305304

                                Source ¦   SUM SQ     ¦  DF ¦   MEAN SQ
                     ¦-----------------¦-------------¦-----¦------------¦
                     ¦Due to Regression ¦  5.762E+005¦    1¦  5.762E+005¦
                     ¦         Residual ¦   88853.127¦    4¦   22213.282¦
                     ¦            Total ¦  6.651E+005¦    5¦  1.330E+005¦
                     ¦-----------------¦-------------¦-----¦------------¦
                                                                        [END]
```

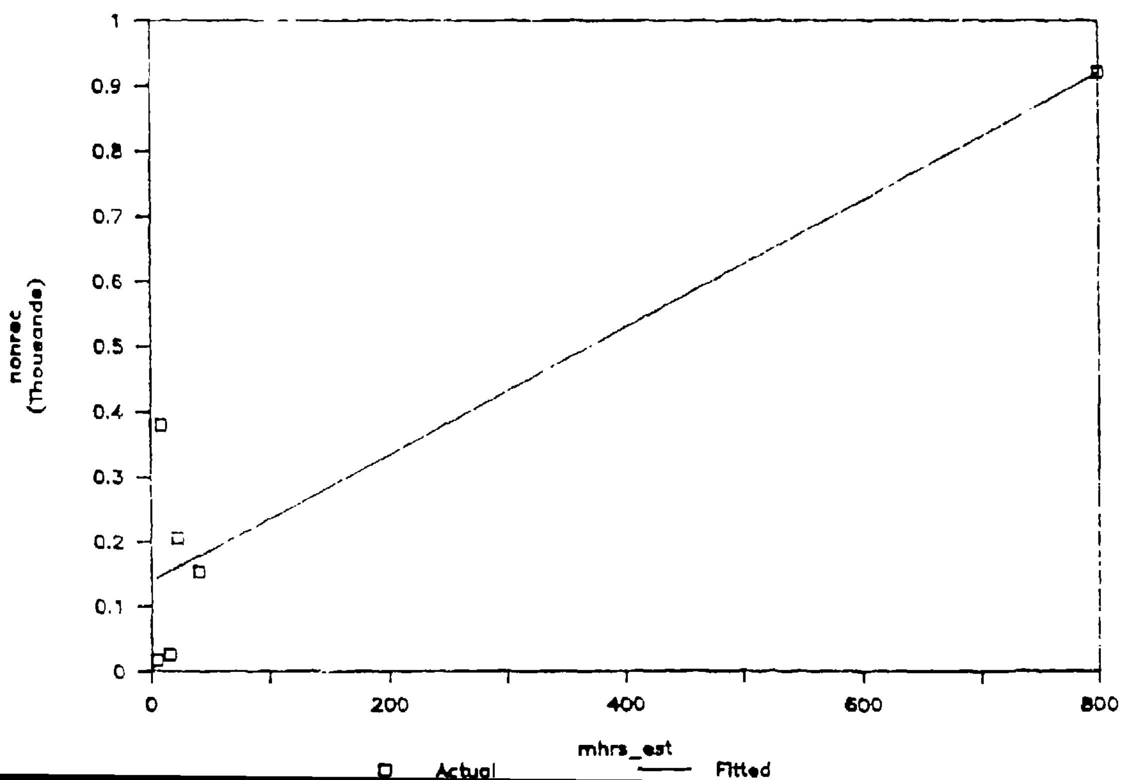
Standard Plot

```
seq. Residual  Min.=-128.00      Mean=0.00        232.06= Max.
         (*)  -+----+----+----+-M0-+----+----+----+----+----+----+-
   1     0.57  ¦                 *                                 ¦
   2   -23.95  ¦             *   .                                 ¦
   3    45.66  ¦                 .      *                          ¦
   4  -128.00  ¦*                .                                 ¦
   5   232.06  ¦                 .                                *¦
   6  -126.33  ¦*                .                                 ¦
```

Standard Plot

```
eq.   Fitted    nonrec  Min.= 16.40                                       921.00= Max.
        (*)       (+)   -+----+----+----+----+----+----+----+----+----+----+-
 1    920.43    921.00  |                                                    @|
 2    177.95    154.00  |        +*                                            |
 3    160.34    206.00  |        *  +                                          |
 4    153.50     25.50  | +      *                                            |
 5    146.94    379.00  |       *            +                                 |
 6    142.73     16.40  |+      *                                              |
```

osnum	osyr	mhrs_est	nonrec	Fitted	Residual
49.00	82.00	800.00	921.00	920.43	0.57
90.00	82.00	41.00	154.00	177.95	-23.95
104.00	83.00	23.00	206.00	160.34	45.66
47.00	81.00	16.00	25.50	153.50	-128.00
114.00	83.00	9.30	379.00	146.94	232.06
114.00	83.00	5.00	16.40	142.73	-126.33



Ref. #7

OLS -- DEPENDENT VARIABLE: KITCAC

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB
1 HWCAC	1.013084116	(0.23118)	T= 4.38221	0.00
2 UNINS	1.595859835	(0.39425)	T= 4.04787	0.00
3 Constant	-4.609636197	(1.05722)	T= -4.36016	0.00

```
SAMPLE SIZE( 46 to   57) =        12        (DF=9)
SUM OF SQUARED RESIDUALS =         4.657179
          VARIANCE (MSE) =         0.517464
TANDARD ERROR (ROOT MSE) =         0.719350
               R-SQUARED =         0.850803
      ADJUSTED R-SQUARED =         0.817649
F-STATISTIC(  2,     9) =        25.661536 (p=0.0002)
       SUM OF RESIDUALS =         -0.000000
DURBIN-WATSON STATISTIC =          2.227829
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	31.215	2	15.608
Residual	4.657	9	0.517
Total	35.872	11	3.261

[END

Standard Plot

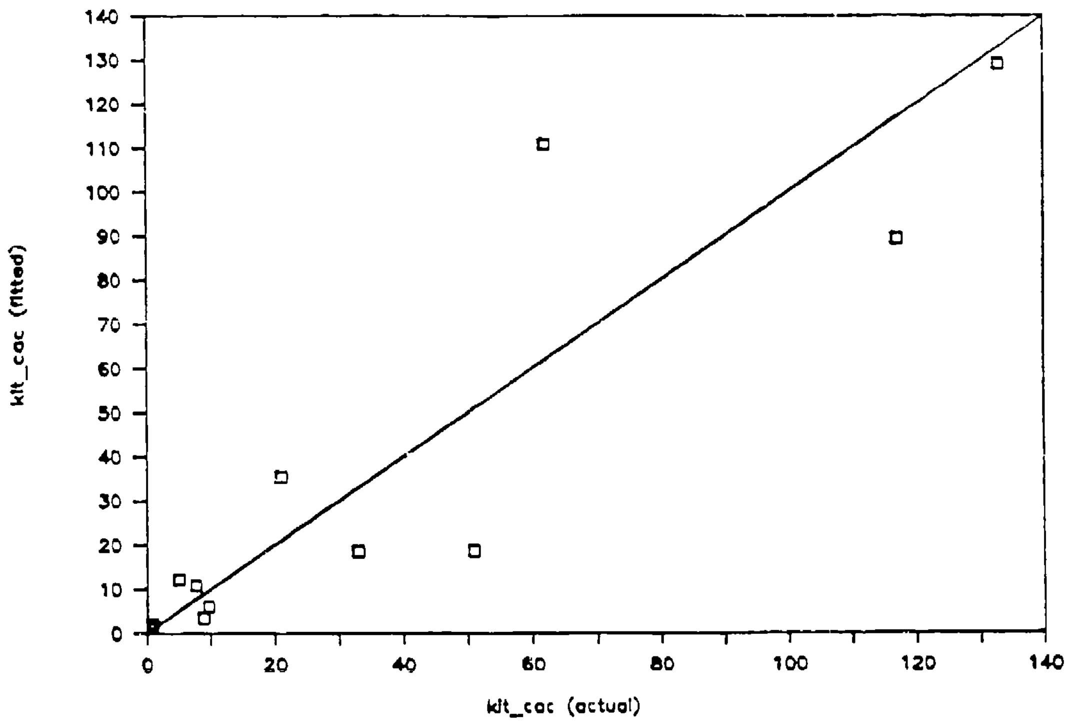
```
seq. residual  Min.=-48.85        Mean=1.07          32.37= Max.
       (*)   -+----+----+----+----+----+----M----+----+----+----+-
 46     3.95 |                              .  *                  |
 47   -48.85 |*                             .                     |
 48    27.61 |                              .              *      |
 49   -14.41 |                    *         .                     |
 50    32.37 |                              .                    *|
 51    14.54 |                              .        *            |
 52    -7.07 |                         *    .                     |
 53    -3.08 |                           *  .                     |
 54     3.65 |                              . *                   |
 55     5.50 |                              .  *                  |
 56    -0.99 |                             *.                     |
 57    -0.34 |                              *                     |
```

Standard Plot

```
seq. fitted     kit_cac  Min.=  0.80                              133.00= Max.
         (*)       (+) -+----+----+-----+----+-----+----+-----+----+----+----+-----+-
 46   129.05    133.00 |                                                          *+|
 47   110.85     62.00 |                        +                   *                |
 48    89.39    117.00 |                                   *                +        |
 49    35.41     21.00 |        +     *                                              |
 50    18.63     51.00 |       *            +                                        |
 51    18.46     33.00 |       *    +                                                |
 52    12.17      5.10 |   + *                                                       |
 53    10.78      7.70 |    +*                                                       |
 54     6.05      9.70 |  *+                                                         |
 55     3.40      8.90 | *  +                                                        |
 56     1.99      1.00 |@                                                            |
 57     1.14      0.80 |@                                                            |
```

osnum	osyr	hw_cac	in_inst	kit_cac	fitted	residual
104.00	79.00	262.00	11.00	133.00	129.05	3.95
104.00	79.00	262.00	10.00	62.00	110.85	-48.85
47.00	81.00	159.00	12.00	117.00	89.39	27.61
60.00	82.00	50.00	14.00	21.00	35.41	-14.41
117.00	84.00	79.00	7.00	51.00	18.63	32.37
26.00	79.00	133.00	5.00	33.00	18.46	14.54
62.00	82.00	197.00	3.00	5.10	12.17	-7.07
5.00	75.00	31.00	9.00	7.70	10.78	-3.08
15.00	80.00	98.79	3.00	9.70	6.05	3.65
47.00	81.00	25.00	5.00	8.90	3.40	5.50
6.00	83.00	21.00	4.00	1.00	1.99	-0.99
5.00	75.00	19.00	3.00	0.80	1.14	-0.34

Ref. #7



klt_cac (fitted)
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
klt_cac (actual)

```
                    OLS  -- DEPENDENT VARIABLE: KITCAC

   RIGHT-HAND            ESTIMATED        STANDARD         T_STATISTIC      PROB
    VARIABLE             COEFFICIENT        ERROR

  1  HWCAC               0.830413207   (       0.03352)    T=    24.77596      0.0(

 SAMPLE SIZE( 46 to   52) =               7          (DF=6)
 SUM OF SQUARED RESIDUALS =               1.038311
          VARIANCE (MSE) =                0.173052
STANDARD ERROR (ROOT MSE) =               0.415995
               R-SQUARED =                0.785601
      ADJUSTED R-SQUARED =                0.749868
  F-STATISTIC(  1,     6) =             613.848138 (p=0.0000)
        SUM OF RESIDUALS =                0.030071
  DURBIN-WATSON STATISTIC =               3.721736

                               Source  |   SUM SQ     |  DF  |  MEAN SQ   |
                    |------------------|--------------|------|------------|
                    |Due to Regression |      107.266|     1|     107.266|
                    |         Residual |        1.038|     6|       0.173|
                    |            Total |      108.304|     7|      15.472|
                    |------------------|--------------|------|------------|
                                                                            [EN]
```

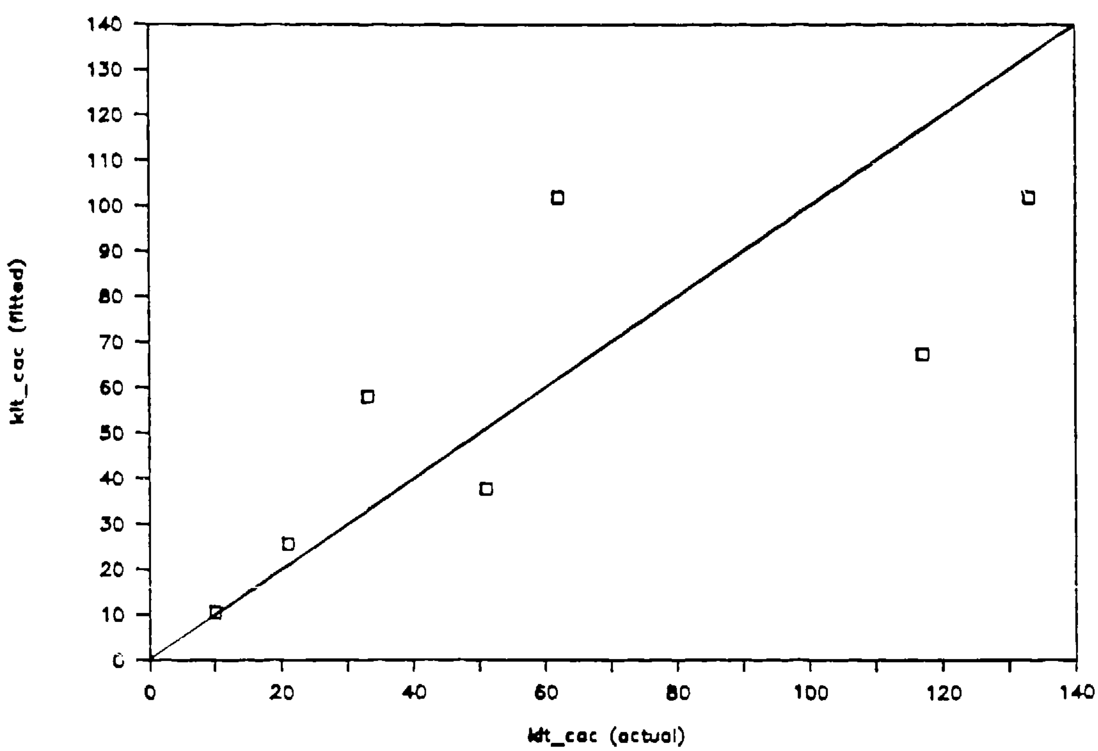
Residual Plot

```
seq.     x58    Min.= -0.53       Mean=0.00         0.56= Max.
          (*)  -+----+----+----+----+---M+----+----+----+----+----+-
 46      0.27  |                          .           *             |
 47     -0.48  |  *                       .                         |
 48      0.56  |                          .                        *|
 49     -0.53  |*                         .                         |
 50      0.32  |                          .             *           |
 51     -0.16  |                *         .                         |
 52      0.05  |                          . *                       |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.= 10.00                                   133.00= Max.
         (*)      (+)   -+----+----+----+----+----+----+----+----+----+----+----+-
 46    101.90   133.00  |                                            *          +|
 47    101.90    62.00  |                       +                    *           |
 48     67.30   117.00  |                         *                        +     |
 49     58.03    33.00  |          +               *                             |
 50     37.65    51.00  |            *        +                                  |
 51     25.75    21.00  |     +  *                                               |
 52     10.51    10.00  |@                                                       |
```

osnum	osyr	hw_cac	kit_cac	Fitted	Residual
104.00	79.00	262.00	133.00	101.90	31.10
104.00	79.00	262.00	62.00	101.90	-39.90
47.00	81.00	159.00	117.00	67.30	49.70
26.00	79.00	133.00	33.00	58.03	-25.03
117.00	84.00	79.00	51.00	37.65	13.35
60.00	82.00	50.00	21.00	25.75	-4.75
68.00	79.00	17.00	10.00	10.51	-0.51



```
                    OLS  -- DEPENDENT VARIABLE: KITCAC

  RIGHT-HAND             ESTIMATED        STANDARD          T_STATISTIC        PROB.
   VARIABLE             COEFFICIENT        ERROR

 1  HWCAC               0.655973871   (       0.07869)    T=     8.33568       0.000

 SAMPLE SIZE( 46 to   58) =              13          (DF=12)
 SUM OF SQUARED RESIDUALS =             18.069157
          VARIANCE (MSE) =               1.505763
STANDARD ERROR (ROOT MSE) =              1.227095
                R-SQUARED =              0.520651
       ADJUSTED R-SQUARED =              0.480705
  F-STATISTIC(  1,    12) =             69.483642 (p=0.0000)
        SUM OF RESIDUALS =              -1.439972
  DURBIN-WATSON STATISTIC =              1.895611
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	122.695	1	122.695
Residual	18.069	12	1.506
Total	140.764	13	10.828

[END]

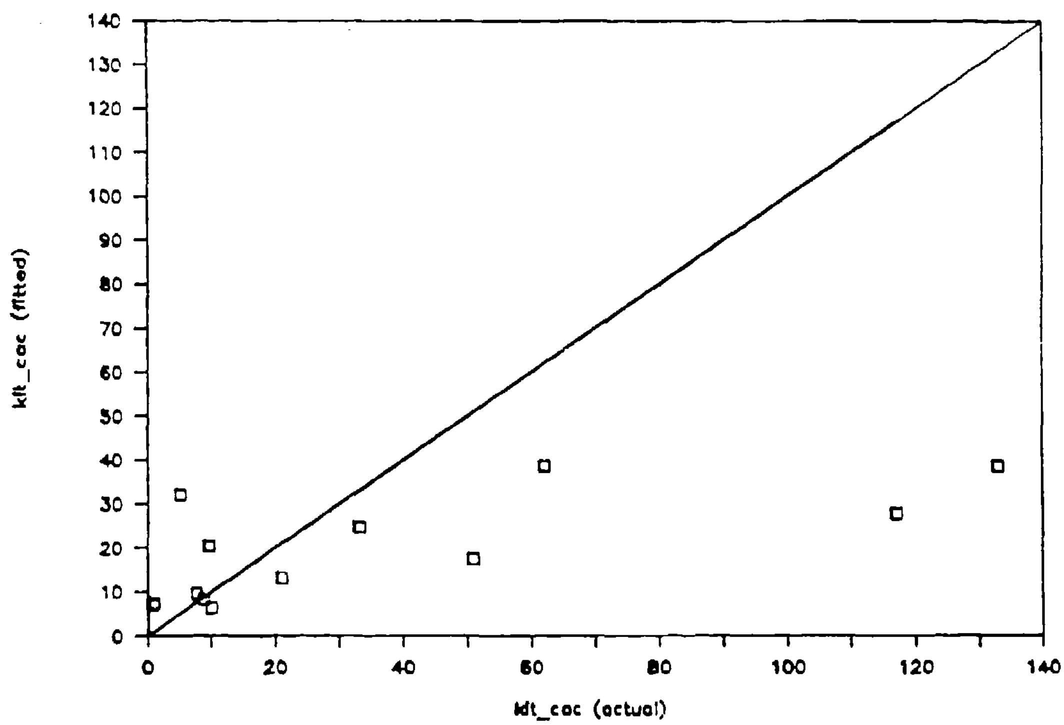
Standard Plot

```
seq. residual  Min.=-26.90       Mean=16.08        94.42= Max.
          (*) -+----+----+0---+-M--+----+----+----+----+----+--
 46     94.42 |            .                                 *|
 47     23.42 |            .        *                         |
 48    -26.90 |*           .                                  |
 49     89.20 |            .                               *  |
 50      8.27 |            .  *                               |
 51    -10.65 |       *    .                                  |
 52     33.43 |            .            *                     |
 53      7.98 |            .  *                               |
 54     -1.81 |           *.                                  |
 55      0.64 |            *                                  |
 56     -6.37 |         *  .                                  |
 57     -6.10 |          * .                                  |
 58      3.59 |            . *                                |
```

Standard Plot

```
seq. fitted    kit_cac  Min.=  0.80                                133.00= Max.
       (*)       (+)   -+----+----+----+----+----+----+----+----+----+-
 46    38.58   133.00 |                  *                                  +|
 47    38.58    62.00 |                  *          +                        |
 48    32.00     5.10 |  +             *                                     |
 49    27.80   117.00 |              *                               +       |
 50    24.73    33.00 |             *  +                                     |
 51    20.35     9.70 |   +      *                                           |
 52    17.57    51.00 |          *           +                               |
 53    13.02    21.00 |        *   +                                         |
 54     9.51     7.70 |    @                                                 |
 55     8.26     8.90 |    @                                                 |
 56     7.37     1.00 |+  *                                                  |
 57     6.90     0.80 |+  *                                                  |
 58     6.41    10.00 |   *+                                                 |
```

osnum	osyr	KITCAC	HWCAC	hw_cac	kit_cac	fitted
104.00	79.00	4.89	5.57	262.00	133.00	38.58
104.00	79.00	4.13	5.57	262.00	62.00	38.58
62.00	82.00	1.63	5.28	197.00	5.10	32.00
47.00	81.00	4.76	5.07	159.00	117.00	27.80
26.00	79.00	3.50	4.89	133.00	33.00	24.73
15.00	80.00	2.27	4.59	98.79	9.70	20.35
117.00	84.00	3.93	4.37	79.00	51.00	17.57
60.00	82.00	3.04	3.91	50.00	21.00	13.02
5.00	75.00	2.04	3.43	31.00	7.70	9.51
47.00	81.00	2.19	3.22	25.00	8.90	8.26
6.00	83.00	0.00	3.04	21.00	1.00	7.37
5.00	75.00	-0.22	2.94	19.00	0.80	6.90
68.00	79.00	2.30	2.83	17.00	10.00	6.41



140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
kft_cac (fitted)
0
20
40
60
80
100
120
140
kft_cac (actual)

OLS -- DEPENDENT VARIABLE: kit_cac

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC		PR
1	hw_cac	0.061925316	(0.05300)	T=	1.16845	0.
2	kit_dims	0.001245379	(0.00018)	T=	6.92703	0.

```
SAMPLE SIZE( 46 to   53) =          8         (DF=6)
SUM OF SQUARED RESIDUALS =     873.187021
           VARIANCE (MSE) =     145.531170
STANDARD ERROR (ROOT MSE) =      12.063630
                R-SQUARED =       0.919541
       ADJUSTED R-SQUARED =       0.892721
   F-STATISTIC(  2,    6) =      49.858607 (p=0.0002)
         SUM OF RESIDUALS =      -9.012161
  DURBIN-WATSON STATISTIC =       1.937004
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	15385.150	2	7692.575
Residual	873.187	6	145.531
Total	16258.337	8	2032.292

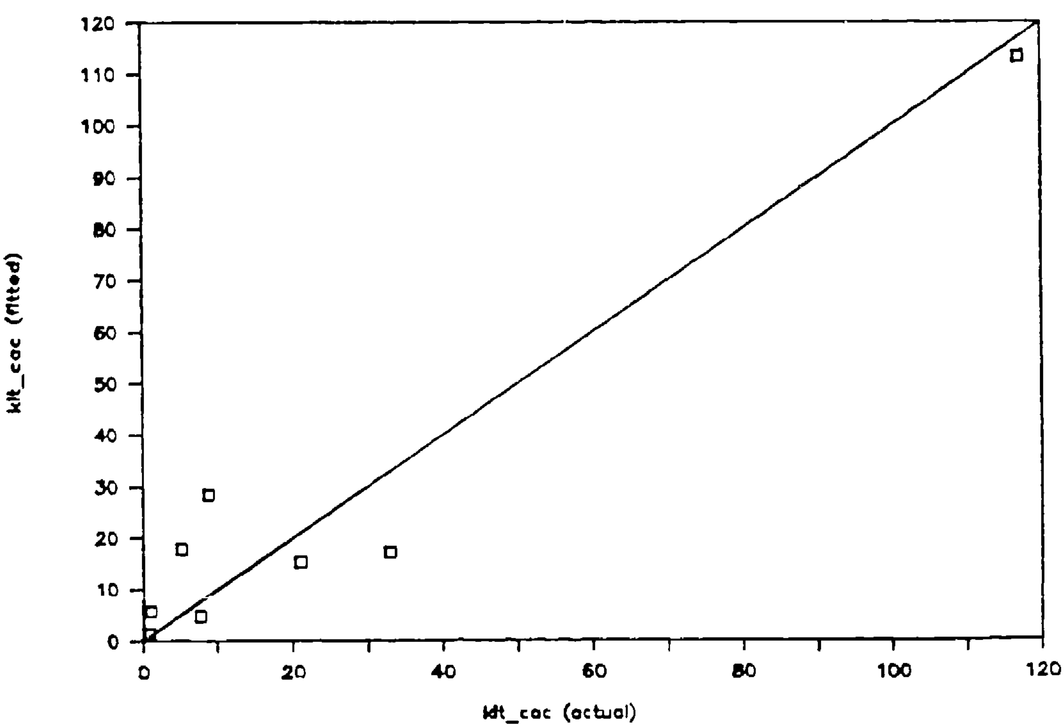
Residual Plot

```
seq.     x58   Min.=-19.55        Mean=-1.13        15.85= Max.
         (*) -+----+----+----+----+----+M-0-+----+----+----+----+-
 46     3.86 |                              .    *                |
 47   -19.55 |*                             .                     |
 48   -12.70 |          *                   .                     |
 49    15.85 |                              .                    *|
 50     5.71 |                              .       *             |
 51    -4.69 |                     *        .                     |
 52     2.98 |                              .   *                 |
 53    -0.46 |                             *.                     |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.=  0.80                          117.00= Max.
         (*)      (+)   -+----+----+----+----+----+----+----+----+----+----+-
 46   113.14   117.00  |                                                * +|
 47    28.45     8.90  |   +        *                                      |
 48    17.80     5.10  |  +    *                                           |
 49    17.15    33.00  |       *     +                                     |
 50    15.29    21.00  |      *  +                                         |
 51     5.69     1.00  |+ *                                                |
 52     4.72     7.70  |  *+                                               |
 53     1.26     0.80  |@                                                  |
```

osnum	osyr	hw_cac	kit_dims	kit_cac	Fitted	Residual
47.00	81.00	159.00	82944.00	117.00	113.14	3.86
47.00	81.00	25.00	21600.00	8.90	28.45	-19.55
62.00	82.00	197.00	4500.00	5.10	17.80	-12.70
26.00	79.00	133.00	7161.00	33.00	17.15	15.85
60.00	82.00	50.00	9792.00	21.00	15.29	5.71
6.00	83.00	21.00	3528.00	1.00	5.69	-4.69
5.00	75.00	31.00	2250.00	7.70	4.72	2.98
5.00	75.00	19.00	64.00	0.80	1.26	-0.46



OLS -- DEPENDENT VARIABLE: kit_cac

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC		PR
1	hw_cac	0.066978950	(0.05593)	T=	1.19751	0.
2	kit_wt	0.393900187	(0.06712)	T=	5.86822	0.

```
SAMPLE SIZE( 46 to   57) =          12         (DF=10)
SUM OF SQUARED RESIDUALS =     2536.412546
          VARIANCE (MSE) =      253.641255
STANDARD ERROR (ROOT MSE) =      15.926119
               R-SQUARED =       0.903272
      ADJUSTED R-SQUARED =       0.883926
  F-STATISTIC(  2,    10) =      68.158919 (p=0.0000)
       SUM OF RESIDUALS =      -42.511270
 DURBIN-WATSON STATISTIC =       1.346057
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	37112.240	2	18556.120
Residual	2536.413	10	253.641
Total	39648.653	12	3304.054

[]

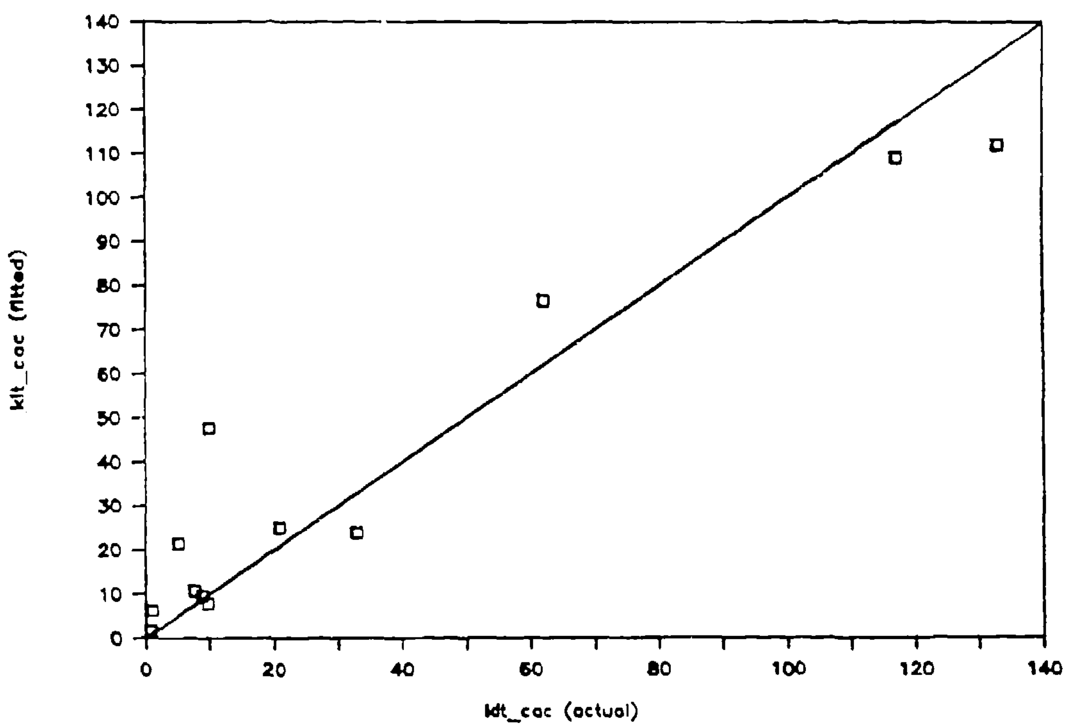
Residual Plot

```
seq.    x58    Min.=-37.62       Mean=-3.54       20.92= Max.
        (*)  -+----+----+----+----+----+---M+-0--+----+----+----+-
 46   20.92  |                                  .                 *|
 47    7.88  |                                  .      *           |
 48  -14.63  |                    *             .                  |
 49  -37.62  |*                                 .                  |
 50   -4.01  |                             *    .                  |
 51    9.12  |                                  .       *          |
 52  -16.37  |                  *               .                  |
 53   -3.04  |                              *   .                  |
 54   -0.65  |                                  *                  |
 55    1.90  |                                  . *                |
 56   -5.13  |                            *     .                  |
 57   -0.87  |                                 *.                  |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.=  0.80                       133.00= Max.
         (*)      (+)   -+----+----+----+----+----+----+----+----+----+-
 46   112.08   133.00  |                                         *      +|
 47   109.12   117.00  |                                        *  +     |
 48    76.63    62.00  |                        +     *                  |
 49    47.62    10.00  |   +             *                               |
 50    25.01    21.00  |       +*                                        |
 51    23.88    33.00  |        *   +                                    |
 52    21.47     5.10  |  +     *                                        |
 53    10.74     7.70  |   +*                                            |
 54     9.55     8.90  |   @                                             |
 55     7.80     9.70  |   @                                             |
 56     6.13     1.00  |+ *                                              |
 57     1.67     0.80  |@                                                |
```

osnum	osyr	kit_wt	hw_cac	kit_cac	Fitted	Residual
104.00	79.00	240.00	262.00	133.00	112.08	20.92
47.00	81.00	250.00	159.00	117.00	109.12	7.88
104.00	79.00	150.00	262.00	62.00	76.63	-14.63
68.00	79.00	118.00	17.00	10.00	47.62	-37.62
60.00	82.00	55.00	50.00	21.00	25.01	-4.01
26.00	79.00	38.00	133.00	33.00	23.88	9.12
62.00	82.00	21.00	197.00	5.10	21.47	-16.37
5.00	75.00	22.00	31.00	7.70	10.74	-3.04
47.00	81.00	20.00	25.00	8.90	9.55	-0.65
15.00	80.00	3.00	98.79	9.70	7.80	1.90
6.00	83.00	12.00	21.00	1.00	6.13	-5.13
5.00	75.00	1.00	19.00	0.80	1.67	-0.87


kit_cac (fitted)
kit_cac (actual)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
20
40
60
80
100
120
140

```
                         OLS  -- DEPENDENT VARIABLE:  kit_cac

   RIGHT-HAND            ESTIMATED         STANDARD          T_STATISTIC        PROB
    VARIABLE            COEFFICIENT         ERROR

  1   uwt_ins           2.110605251    (      0.51639)    T=     4.08725       0.00
  2  wir_chge           4.720593501    (     25.01102)    T=     0.18874       0.85

 SAMPLE SIZE(  1 to    12) =           12          (DF=10)
 SUM OF SQUARED RESIDUALS =        119660.777418
          VARIANCE (MSE) =          11966.077742
STANDARD ERROR (ROOT MSE) =           109.389569
               R-SQUARED =              0.795710
      ADJUSTED R-SQUARED =              0.754852
  F-STATISTIC(  2,    10) =            19.628723 (p=0.0003)
        SUM OF RESIDUALS =          -356.753743
  DURBIN-WATSON STATISTIC =             2.028101

                                   Source |  SUM SQ       |  DF |  MEAN SQ
                        ------------------|---------------|-----|------------|
                        |Due to Regression |  5.894E+005|    2|  2.947E+005|
                        |         Residual |  1.197E+005|   10|   11966.078|
                        |            Total |  7.091E+005|   12|   59089.934|
                        ------------------|---------------|-----|------------|
                                                                            [ENI
```

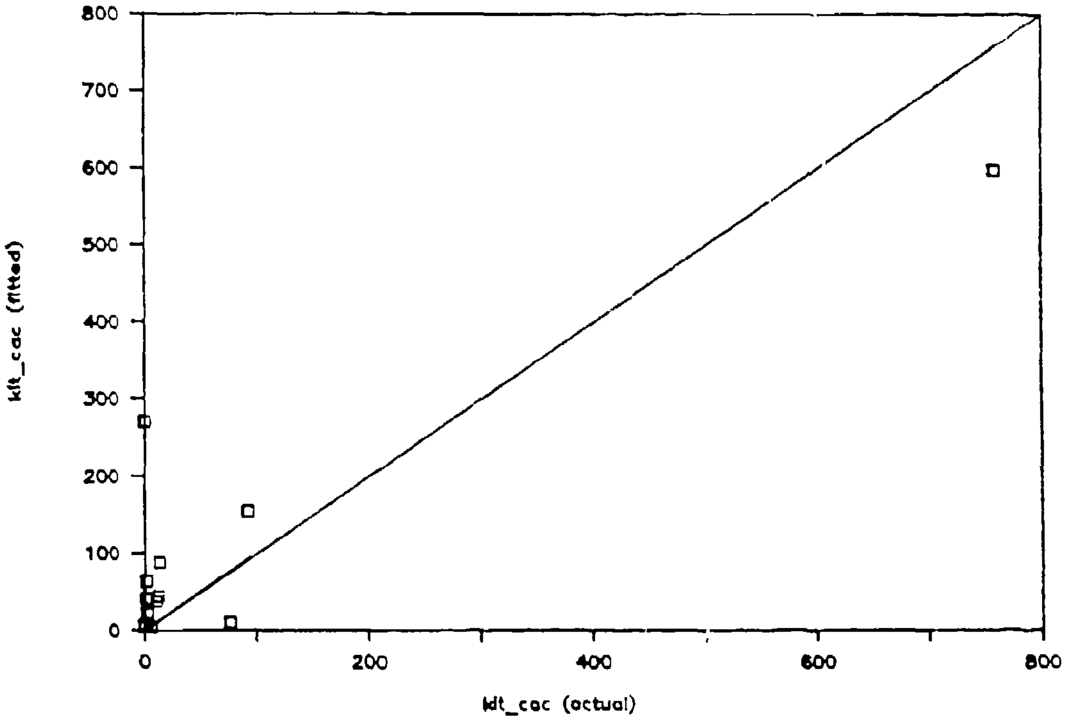
Residual Plot

```
seq. Residual  Min.=-269.40      Mean=-29.73      161.23= Max.
          (*)  -+----+----+----+----+-----+-M--+0---+----+----+-----+-
  1    161.23  |                                .                    *|
  2   -269.40  |*                               .                     |
  3    -61.53  |                         *      .                     |
  4    -74.87  |                        *       .                     |
  5    -60.74  |                         *      .                     |
  6    -31.37  |                             *  .                     |
  7    -37.76  |                            *   .                     |
  8    -26.93  |                             *  .                     |
  9    -19.11  |                              * .                     |
 10     66.96  |                                .        *            |
 11     -4.62  |                                *                     |
 12      1.38  |                                *                     |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.=  0.10                       758.00= Max.
          (*)      (+) -+----+----+----+----+----+----+----+----+----+----+-
  1    596.77   758.00 |                                       *          +|
  2    269.60     0.20 |+                 *                                |
  3    153.73    92.20 |      +   *                                        |
  4     88.17    13.30 | +    *                                            |
  5     62.84     2.10 |+   *                                              |
  6     44.27    12.90 | + *                                               |
  7     39.86     2.10 |+  *                                               |
  8     37.93    11.00 | +*                                                |
  9     21.61     2.50 |+*                                                 |
 10      9.44    76.40 | *   +                                             |
 11      4.72     0.10 |@                                                  |
 12      4.72     6.10 |@                                                  |
```

osnum	osyr	wir_chge	uwt_ins	kit_cac	Fitted	Residual
49.00	82.00	4.00	273.80	758.00	596.77	161.23
8.00	78.00	1.00	125.50	0.20	269.60	-269.40
23.00	79.00	1.00	70.60	92.20	153.73	-61.53
31.00	82.00	2.00	37.30	13.30	88.17	-74.87
8.00	78.00	2.00	25.30	2.10	62.84	-60.74
22.00	78.00	2.00	16.50	12.90	44.27	-31.37
22.00	78.00	1.00	16.65	2.10	39.86	-37.76
22.00	79.00	2.00	13.50	11.00	37.93	-26.93
104.00	79.00	1.00	8.00	2.50	21.61	-19.11
104.00	79.00	2.00	0.00	76.40	9.44	66.96
7.00	72.00	1.00	0.00	0.10	4.72	-4.62
8.00	78.00	1.00	0.00	6.10	4.72	1.38



800
700
600
500
400
300
200
100
0
0
200
400
600
800
kit_cac (fitted)
kit_cac (actual)

OLS -- DEPENDENT VARIABLE: kit_cac

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PR
1 uwt_ins	1.382795263	(0.39194)	T= 3.52808	0.
2 kit_wt	0.774648779	(0.28121)	T= 2.75474	0.

SAMPLE SIZE(1 to 19) =	19 (DF=17)
SUM OF SQUARED RESIDUALS =	116136.709196
VARIANCE (MSE) =	6831.571129
STANDARD ERROR (ROOT MSE) =	82.653319
R-SQUARED =	0.795570
ADJUSTED R-SQUARED =	0.771520
F-STATISTIC(2, 17) =	38.144472 (p=0.0000)
SUM OF RESIDUALS =	-222.424522
DURBIN-WATSON STATISTIC =	1.614376

Source	SUM SQ	DF	MEAN SQ
Due to Regression	6.373E+005	2	3.187E+005
Residual	1.161E+005	17	6831.571
Total	7.534E+005	19	39655.093

(E

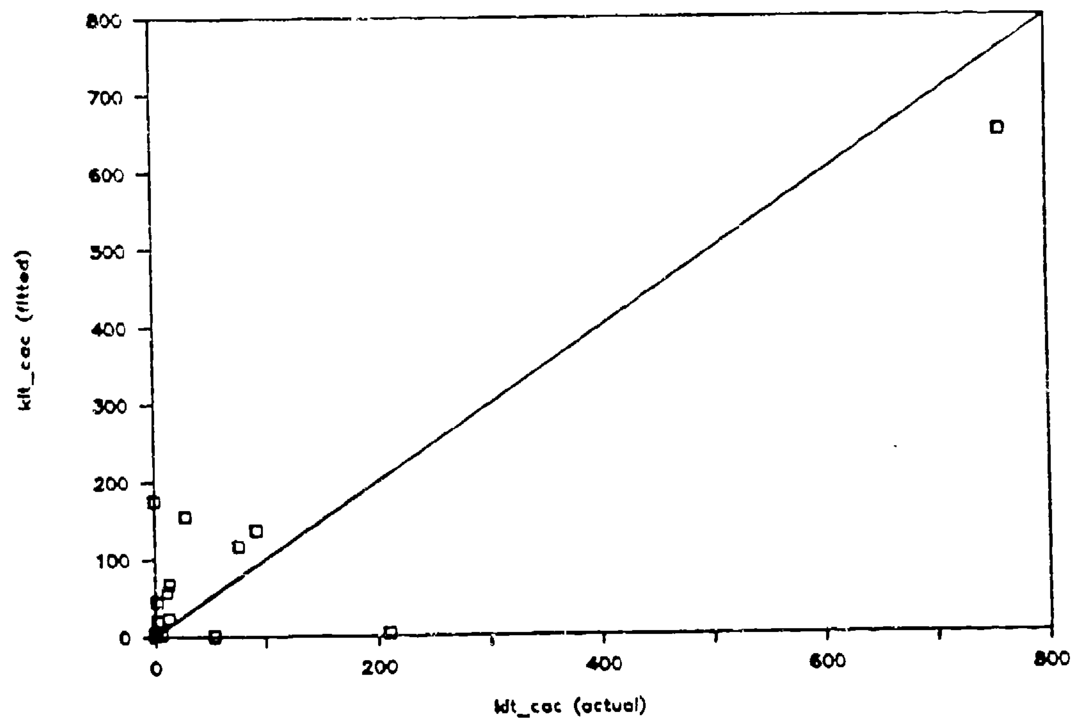
Residual Plot

```
seq.    x58     Min.=-174.12      Mean=-11.71       206.90= Max.
        (*)  -+----+----+----+----+M-0-+----+----+----+----+----+-
 1    108.26 |                         .            *           |
 2   -174.12 |*                        .                        |
 3   -126.33 |     *                   .                        |
 4    -44.16 |               *         .                        |
 5    -39.80 |                *        .                        |
 6    -53.77 |              *          .                        |
 7    -46.40 |               *         .                        |
 8    -41.84 |               *         .                        |
 9    -41.41 |               *         .                        |
10    -10.11 |                       * .                        |
11    -16.31 |                      *  .                        |
12    206.90 |                         .                       *|
13      2.90 |                         *                        |
14     -2.61 |                         *                        |
15      4.16 |                         *                        |
16     -0.67 |                         *                        |
17     -0.58 |                         *                        |
18     53.74 |                         .     *                  |
19     -0.29 |                         *                        |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.=  0.00                         758.00= Max.
          (*)      (+)  -+----+----+----+----+----+----+----+----+----+----+-
  1    649.74   758.00  |                                            *      +|
  2    174.32     0.20  |+          *                                        |
  3    154.93    28.60  |  +       *                                         |
  4    136.36    92.20  |      +  *                                          |
  5    116.20    76.40  |     +  *                                           |
  6     67.07    13.30  | +  *                                               |
  7     57.40    11.00  | +  *                                               |
  8     43.94     2.10  |+  *                                                |
  9     43.51     2.10  |+  *                                                |
 10     23.01    12.90  | +*                                                 |
 11     18.81     2.50  |+*                                                  |
 12      3.10   210.00  |*             +                                     |
 13      3.10     6.00  |@                                                   |
 14      2.71     0.10  |@                                                   |
 15      1.94     6.10  |@                                                   |
 16      0.77     0.10  |@                                                   |
 17      0.58     0.00  |@                                                   |
 18      0.46    54.20  |*   +                                               |
 19      0.39     0.10  |@                                                   |
```

osnum	osyr	uwt_ins	kit_wt	kit_cac	Fitted	Residual
49.00	82.00	273.80	350.00	758.00	649.74	108.26
8.00	78.00	125.50	1.00	0.20	174.32	-174.12
104.00	79.00	0.00	200.00	28.60	154.93	-126.33
23.00	79.00	70.60	50.00	92.20	136.36	-44.16
104.00	79.00	0.00	150.00	76.40	116.20	-39.80
31.00	82.00	37.30	20.00	13.30	67.07	-53.77
22.00	79.00	13.50	50.00	11.00	57.40	-46.40
22.00	78.00	16.65	27.00	2.10	43.94	-41.84
8.00	78.00	25.30	11.00	2.10	43.51	-41.41
22.00	78.00	16.50	0.25	12.90	23.01	-10.11
104.00	79.00	8.00	10.00	2.50	18.81	-16.31
102.00	79.00	0.00	4.00	210.00	3.10	206.90
101.00	83.00	0.00	4.00	6.00	3.10	2.90
47.00	81.00	0.00	3.50	0.10	2.71	-2.61
8.00	78.00	0.00	2.50	6.10	1.94	4.16
104.00	79.00	0.00	1.00	0.10	0.77	-0.67
1.00	77.00	0.00	0.75	0.00	0.58	-0.58
8.00	78.00	0.00	0.60	54.20	0.46	53.74
7.00	72.00	0.00	0.50	0.10	0.39	-0.29


800
700
600
500
400
300
200
100
0
klt_cac (fitted)
0
200
400
600
800
klt_cac (actual)

OLS -- DEPENDENT VARIABLE: inst_cac

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 kit_dims	0.001382677	(0.00015)	T= 9.00591	0.000

```
SAMPLE SIZE( 46 to   55) =           10          (DF=9)
SUM OF SQUARED RESIDUALS =         6051.853433
           VARIANCE (MSE) =          672.428159
STANDARD ERROR (ROOT MSE) =           25.931220
                R-SQUARED =            0.874448
       ADJUSTED R-SQUARED =            0.860498
  F-STATISTIC(  1,     9) =           81.106363 (p=0.0048)
      SUM OF RESIDUALS =             -32.885194
 DURBIN-WATSON STATISTIC =            1.699384
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	60590.056	1	60590.056
Residual	6051.853	9	672.428
Total	66641.909	10	6664.191

[END]

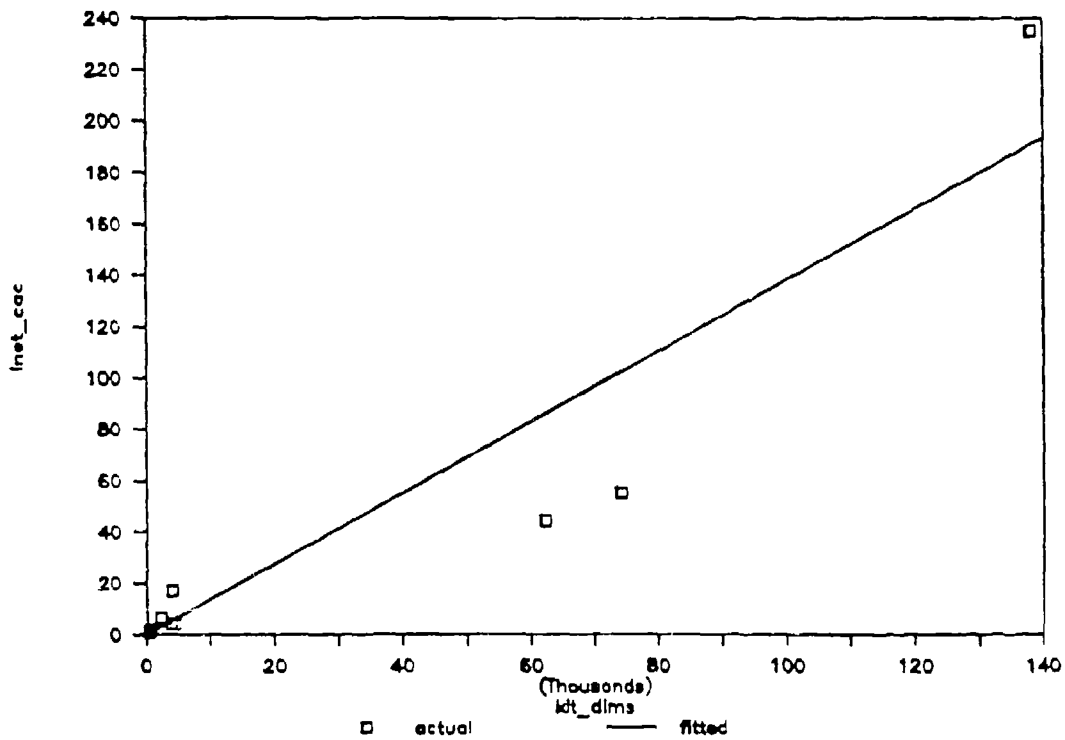
Residual Plot

```
seq.    x58   Min.=-47.34       Mean=-3.29        43.86= Max.
        (*)  -+----+----+----+----+---M+0---+----+----+----+----+-
 46    43.86 |                               .                        *|
 47   -47.34 |*                              .                         |
 48   -41.71 |   *                           .                         |
 49    -2.22 |                              *.                         |
 50    11.34 |                               .      *                  |
 51    -1.38 |                              *.                         |
 52     3.36 |                               .  *                      |
 53     0.54 |                               *                         |
 54     0.19 |                               *                         |
 55     0.48 |                               *                         |
```

Standard Plot

```
seq.    Fitted inst_cac  Min.=  0.09                               235.00= Max.
          (*)      (+)  -+----+----+----+----+----+----+----+----+----+----+-
 46     191.14   235.00 |                                             *     +|
 47     102.44    55.10 |             +          *                           |
 48      86.01    44.30 |          +        *                                |
 49       6.22     4.00 | @                                                  |
 50       5.66    17.00 | *   +                                              |
 51       5.38     4.00 | @                                                  |
 52       3.11     6.47 | @                                                  |
 53       1.06     1.60 |@                                                   |
 54       0.71     0.90 |@                                                   |
 55       0.09     0.57 |@                                                   |
```

osnum	osyr	kit_dims	inst_cac	Fitted	Residual
10.00	77.00	138240.00	235.00	191.14	43.86
1.00	77.00	74088.00	55.10	102.44	-47.34
53.00	72.00	62208.00	44.30	86.01	-41.71
62.00	82.00	4500.00	4.00	6.22	-2.22
62.00	82.00	4096.00	17.00	5.66	11.34
53.00	72.00	3888.00	4.00	5.38	-1.38
5.00	75.00	2250.00	6.47	3.11	3.36
53.00	72.00	768.00	1.60	1.06	0.54
1.00	77.00	512.00	0.90	0.71	0.19



Ref. #15

```
                    OLS  -- DEPENDENT VARIABLE: inst_cac

  RIGHT-HAND            ESTIMATED          STANDARD          T_STATISTIC         PROB.
   VARIABLE            COEFFICIENT          ERROR

 1   kit_cac           0.253667706    (       0.03508)    T=     7.23142        0.002
 2  Constant           4.684378484    (       2.86282)    T=     1.63628        0.177

SAMPLE SIZE( 46 to    51) =            6          (DF=4)
SUM OF SQUARED RESIDUALS =           156.812895
         VARIANCE (MSE) =            39.203224
TANDARD ERROR (ROOT MSE) =            6.261248
              R-SQUARED =            0.928944
     ADJUSTED R-SQUARED =            0.911180
 F-STATISTIC(   1,     4) =           52.293471 (p=0.0019)
       SUM OF RESIDUALS =            0.000000
 DURBIN-WATSON STATISTIC =            1.844084

                         Source |  SUM SQ      |  DF |  MEAN SQ
                   |------------------|-------------|-----|------------|

                   |Due to Regression |      2206.886|    1|     2206.886|
                   |          Residual |       156.813|    4|       39.203|
                   |             Total |      2363.698|    5|      472.740|
                   |------------------|-------------|-----|------------|
                                                                             [END]
```

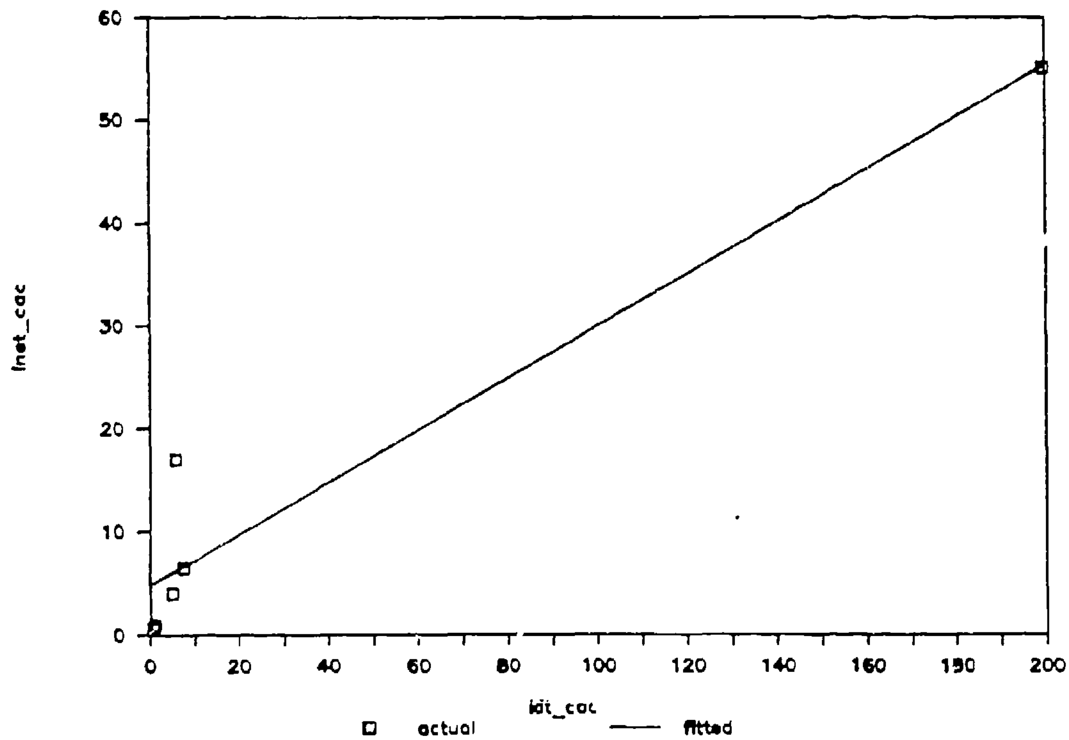
Standard Plot

```
seq. Residual  Min.= -4.32       Mean=0.00          10.82= Max.
         (*)  -+----+----+---M+----+----+----+----+----+----+----+-
  46    -0.22 |              *                                    |
  47    -0.17 |              *                                    |
  48    10.82 |              .                                   *|
  49    -1.98 |        *     .                                    |
  50    -4.14 | *            .                                    |
  51    -4.32 |*             .                                    |
```

Standard Plot

```
seq.   Fitted  kit_cac  Min.=  0.80                                   199.60= Max.
        (*)     (+)   -+----+----+----+----+----+----+----+----+----+----+-
 46    55.32   199.60 |                *                                   +|
 47     6.64     7.70 | *+                                                  |
 48     6.18     5.90 | @                                                   |
 49     5.98     5.10 | @                                                   |
 50     5.04     1.40 |+*                                                   |
 51     4.89     0.80 |+*                                                   |
```

osnum	osyr	inst_cac	kit_cac	Fitted	Residual
1.00	77.00	55.10	199.60	55.32	-0.22
5.00	75.00	6.47	7.70	6.64	-0.17
62.00	82.00	17.00	5.90	6.18	10.82
62.00	82.00	4.00	5.10	5.98	-1.98
1.00	77.00	0.90	1.40	5.04	-4.14
5.00	75.00	0.57	0.80	4.89	-4.32



[redacted]

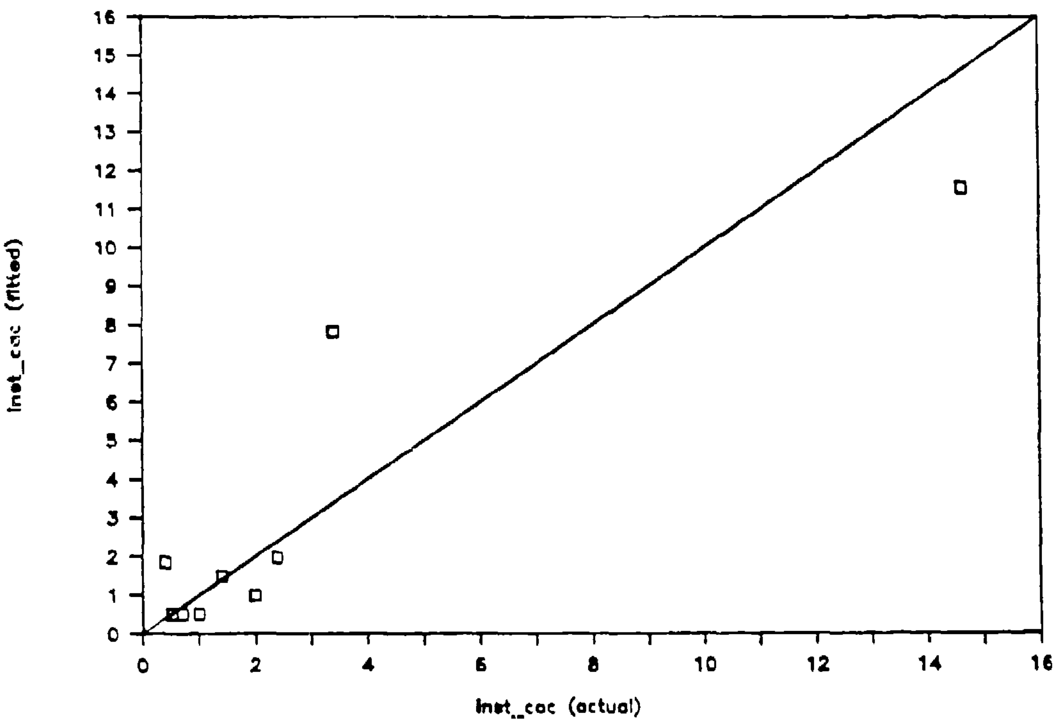
```
                        OLS  -- DEPENDENT VARIABLE: inst_cac

  RIGHT-HAND               ESTIMATED          STANDARD           T_STATISTIC        PROB.
   VARIABLE               COEFFICIENT          ERROR

 1  uin/mod               0.495842650    (       0.37583)    T=       1.31934       0.229
 2   twt_ins              0.277150701    (       0.05272)    T=       5.25662       0.001

 SAMPLE SIZE(  1 to    9) =              9         (DF=7)
 SUM OF SQUARED RESIDUALS =             32.467201
           VARIANCE (MSE) =              4.638172
STANDARD ERROR (ROOT MSE) =              2.153641
                R-SQUARED =              0.798721
       ADJUSTED R-SQUARED =              0.741213
  F-STATISTIC(  2,      7) =            22.200483 (p=0.0009)
        SUM OF RESIDUALS =              -0.748570
  DURBIN-WATSON STATISTIC =              2.678231

                          Source |   SUM SQ      |  DF  |  MEAN SQ
                 |---------------|---------------|------|------------|
                 |Due to Regression |    238.406|    2|     119.203|
                 |       Residual |      32.467|    7|       4.638|
                 |          Total |     270.874|    9|      30.097|
                 |---------------|---------------|------|------------|
                                                                     [END]
```

```
                                      Residual Plot

seq.       x60    Min.= -4.42       Mean=-0.08         3.05= Max.
           (*)  -+----+----+----+----+----+---M0----+----+----+----+-
  1       3.05  |                                .                  *|
  2      -4.42  |*                               .                   |
  3       0.42  |                                . *                 |
  4      -1.45  |                   *            .                   |
  5      -0.07  |                               *.                   |
  6       1.01  |                                .     *             |
  7       0.01  |                                *                   |
  8       0.20  |                                .*                  |
  9       0.50  |                                .  *                |
```

Standard Plot

```
seq.   Fitted inst_cac  Min.=  0.40                          14.60= Max.
         (*)      (+)   -+----+----+----+----+----+----+----+----+----+-
  1    11.55    14.60   |                                        *     +|
  2     7.82     3.40   |          +                 *                  |
  3     1.98     2.40   |      *+                                       |
  4     1.85     0.40   |+    *                                         |
  5     1.49     1.42   |    @                                          |
  6     0.99     2.00   |  *    +                                       |
  7     0.50     0.51   |@                                              |
  8     0.50     0.70   |*+                                             |
  9     0.50     1.00   |*  +                                           |
```

osnum	osyr	uin/mod	twt_ins	inst_cac	Fitted	Residual
22.00	78.00	2.00	38.10	14.60	11.55	3.05
22.00	78.00	2.00	24.65	3.40	7.82	-4.42
101.00	83.00	4.00	0.00	2.40	1.98	0.42
53.00	72.00	1.00	4.90	0.40	1.85	-1.45
18.00	80.00	3.00	0.00	1.42	1.49	-0.07
10.00	77.00	2.00	0.00	2.00	0.99	1.01
18.00	80.00	1.00	0.00	0.51	0.50	0.01
27.00	25.00	1.00	0.00	0.70	0.50	0.20
1.00	77.00	1.00	0.00	1.00	0.50	0.50


inst_cac (fitted)
inst_cac (actual)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
0 2 4 6 8 10 12 14 16

```
                    OLS  -- DEPENDENT VARIABLE: INSCAC

  RIGHT-HAND           ESTIMATED         STANDARD          T_STATISTIC       PROB.
   VARIABLE           COEFFICIENT         ERROR

 1  KITCAC            1.037729424    (       0.17619)    T=      5.88988      0.010

 SAMPLE SIZE(  1 to    30) =             4         (DF=3)
 SUM OF SQUARED RESIDUALS =              1.494709
           VARIANCE (MSE) =              0.498236
STANDARD ERROR (ROOT MSE) =              0.705859
                R-SQUARED =              0.567128
       ADJUSTED R-SQUARED =              0.422838
  F-STATISTIC(  1,      3) =            34.690690 (p=0.0098)
        SUM OF RESIDUALS =               0.062899
  DURBIN-WATSON STATISTIC =              0.193878
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	18.779	1	18.779
Residual	1.495	3	0.498
Total	20.274	4	5.068

[END]

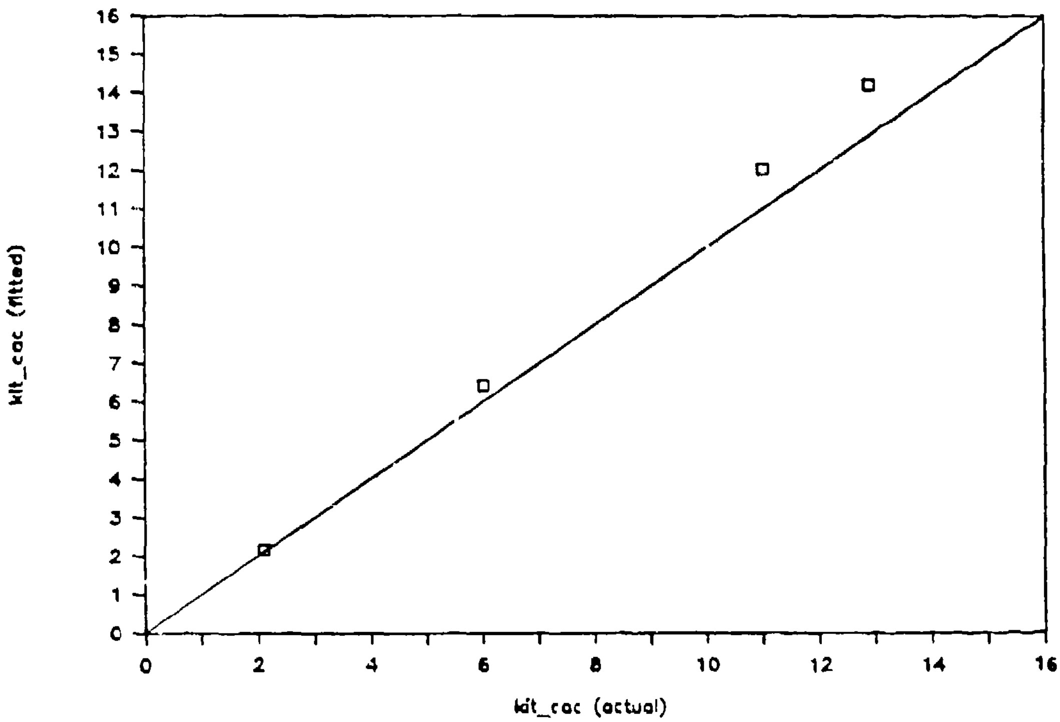
Standard Plot

```
seq. residual  Min.= -4.02        Mean=1.69         9.16= Max.
          (*)  -+----+----+----0----+M---+----+----+----+----+----+-
  1       0.39 |                    . *                               |
  2       9.16 |                    .                                *|
  3      -4.02 |*                   .                                 |
  4       1.24 |                    .    *                            |
```

Standard Plot

```
seq. fitted   inst_cac  Min.=  2.16                         21.20= Max.
        (*)       (+)  -+----+----+----+----+----+----+----+----+----+-
  1    14.21     14.60 |                                  *+          |
  2    12.04     21.20 |                            *                +|
  3     6.42      2.40 | +         *                                  |
  4     2.16      3.40 |*   +                                         |
```

osnum	osyr	inst_cac	kit_cac	fitted	residual
22.00	78.00	14.60	12.90	14.21	0.39
62.00	82.00	21.20	11.00	12.04	9.16
101.00	83.00	2.40	6.00	6.42	-4.02
22.00	78.00	3.40	2.10	2.16	1.24



```
                      OLS  -- DEPENDENT VARIABLE: INSCAC

 RIGHT-HAND            ESTIMATED         STANDARD          T_STATISTIC      PROB.
  VARIABLE            COEFFICIENT         ERROR

1  KITDIMS             0.653656245    (     0.10364)   T=     6.30710     0.000
2  Constant           -3.669295653    (     0.83901)   T=    -4.37337     0.000

SAMPLE SIZE(  1 to   19) =           19         (DF=17)
SUM OF SQUARED RESIDUALS =           16.285015
           VARIANCE (MSE) =           0.957942
STANDARD ERROR (ROOT MSE) =           0.978745
                R-SQUARED =           0.700596
       ADJUSTED R-SQUARED =           0.682984
  F-STATISTIC(  1,    17) =          39.779545 (p=0.0286)
        SUM OF RESIDUALS =          -0.000000
  DURBIN-WATSON STATISTIC =           1.066253
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	54.392	1	54.392
Residual	16.285	17	0.958
Total	70.677	18	3.926

[END]

Standard Plot

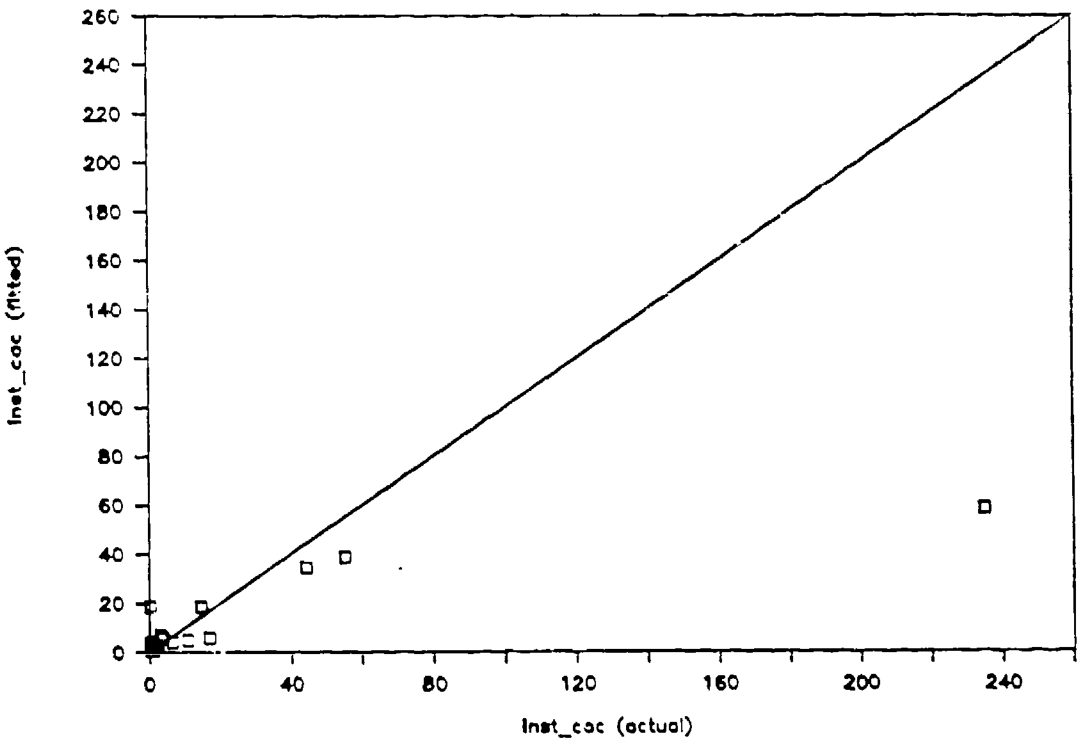
```
seq. residual  Min.= -7.49      Mean=10.72      176.82= Max.
          (*) -+-0-M+----+----+----+----+----+----+----+----+----+-
  1    176.82 |   .                                                *|
  2     16.40 |   .  *                                              |
  3      9.78 |   . *                                               |
  4     11.17 |   . *                                               |
  5     -4.02 | *.                                                  |
  6      6.12 |   . *                                               |
  7      2.53 |   .*                                                |
  8     -1.64 |  *                                                  |
  9     -2.20 | *.                                                  |
 10     -3.40 | *.                                                  |
 11     -0.00 |   *                                                 |
 12     -0.55 |   *                                                 |
 13     -0.35 |   *                                                 |
 14      1.00 |   *                                                 |
 15      0.21 |   *                                                 |
 16     -0.60 |   *                                                 |
 17      0.19 |   *                                                 |
 18     -0.34 |   *                                                 |
 19     -7.49 |*  .                                                 |
```

Standard Plot

```
seq. fitted   inst_cac  Min.=  0.38                               235.00= Max.
        (*)        (+)  -+----+----+----+----+----+----+----+----+----+----+-
  1    58.18    235.00  |              *                                        +|
  2    38.70     55.10  |          *    +                                        |
  3    34.52     44.30  |         * +                                            |
  4     5.83     17.00  | *   +                                                 |
  5    18.62     14.60  |    +*                                                 |
  6     4.78     10.90  | *+                                                    |
  7     3.94      6.47  | @                                                     |
  8     5.64      4.00  | @                                                     |
  9      .20      4.00  | @                                                     |
 10     6.80      3.40  | @                                                     |
 11     2.40      2.40  |@                                                      |
 12     2.55      2.00  |@                                                      |
 13     1.95      1.60  |@                                                      |
 14     0.42      1.42  |@                                                      |
 15     0.79      1.00  |@                                                      |
 16     1.50      0.90  |@                                                      |
 17     0.38      0.57  |@                                                      |
 18     0.85      0.51  |@                                                      |
 19     7.89      0.40  |+  *                                                   |
```

osnum	osyr	kit_dims	inst_cac	fitted	residual
10.00	77.00	138240.00	235.00	58.18	176.82
1.00	77.00	74088.00	55.10	38.70	16.40
53.00	72.00	62208.00	44.30	34.52	9.78
62.00	82.00	4096.00	17.00	5.83	11.17
22.00	78.00	24192.00	14.60	18.62	-4.02
53.00	72.00	3024.00	10.90	4.78	6.12
5.00	75.00	2250.00	6.47	3.94	2.53
53.00	72.00	3888.00	4.00	5.64	-1.64
62.00	82.00	4500.00	4.00	6.20	-2.20
22.00	78.00	5184.00	3.40	6.80	-3.40
101.00	83.00	1056.00	2.40	2.40	-0.00
10.00	77.00	1152.00	2.00	2.55	-0.55
53.00	72.00	768.00	1.60	1.95	-0.35
18.00	80.00	72.00	1.42	0.42	1.00
1.00	77.00	192.00	1.00	0.79	0.21
1.00	77.00	512.00	0.90	1.50	-0.60
5.00	75.00	64.00	0.57	0.38	0.19
18.00	80.00	216.00	0.51	0.85	-0.34
53.00	72.00	6500.00	0.40	7.89	-7.49

Ref. #1



260
240
220
200
180
160
140
120
100
80
60
40
20
0
Inst_coc (fitted)
0
40
80
120
160
200
240
Inst_coc (actual)

OLS -- DEPENDENT VARIABLE: inst_cac

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 kit_dims	0.001365231	(0.00011)	T= 12.24249	0.000

```
            SAMPLE SIZE(  1 to   19) =          19        (DF=18)
       SUM OF SQUARED RESIDUALS =        6534.738665
                 VARIANCE (MSE) =         363.041037
     STANDARD ERROR (ROOT MSE) =          19.053636
                      R-SQUARED =           0.877918
             ADJUSTED R-SQUARED =           0.871136
       F-STATISTIC(  1,     18) =         149.878493 (p=0.0000)
               SUM OF RESIDUALS =         -47.962403
       DURBIN-WATSON STATISTIC =           1.469369
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	60946.782	1	60946.782
Residual	6534.739	18	363.041
Total	67481.521	19	3551.659

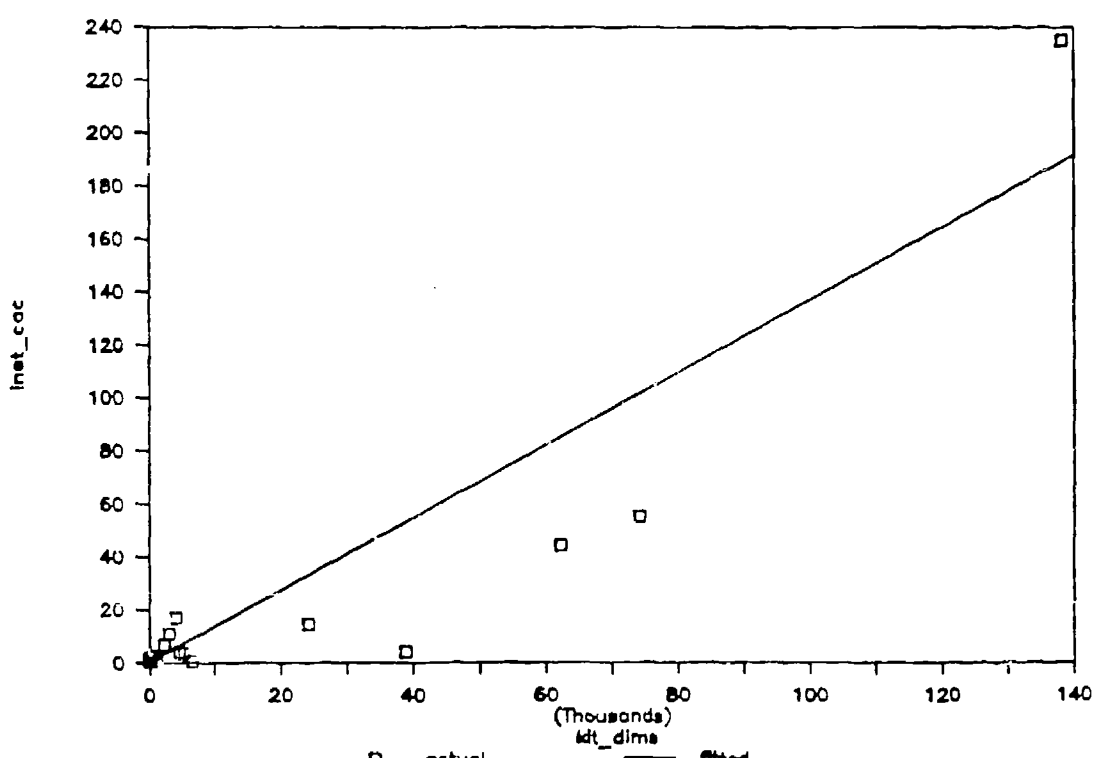
[END]

Residual Plot

```
seq.     x58    Min.=-46.05        Mean=-2.52        46.27= Max.
         (*)  -+----+----+----+----+--M-0----+----+----+----+----+-
  1     46.27 |                           .                         *|
  2    -46.05 |*                          .                          |
  3    -40.63 |   *                       .                          |
  4    -18.43 |              *            .                          |
  5     -8.47 |                   *       .                          |
  6     -3.68 |                      *    .                          |
  7     -2.14 |                       *.                             |
  8     11.41 |                           .       *                  |
  9     -1.31 |                       *.                             |
 10      6.77 |                           .    *                     |
 11      3.40 |                           .  *                       |
 12      0.43 |                           *                          |
 13      0.96 |                           *                          |
 14      0.55 |                           *                          |
 15      0.20 |                           *                          |
 16      0.22 |                           *                          |
 17      0.74 |                           *                          |
 18      1.32 |                           .*                         |
 19      0.48 |                           *                          |
```

Standard Plot

```
seq.   Fitted mhrs_100  Min.=  0.09                         716.25= Max.
         (*)      (+)   -+----+----+----+----+----+----+----+----+----+----+-
  1    188.73   716.25  |                *                                  +|
  2    101.15   465.32  |           *                        +               |
  3     84.93   567.16  |          *                               +         |
  4     33.03   178.13  |    *               +                               |
  5      8.87     4.73  |+*                                                  |
  6      7.08    29.89  |*  +                                                |
  7      6.14   149.00  |*                +                                  |
  8      5.59   391.00  |*                                +                  |
  9      5.31    51.09  |*     +                                             |
 10      4.13   139.89  |*                +                                  |
 11      3.07   138.22  |*                +                                  |
 12      1.57     5.01  |@                                                   |
 13      1.44     2.64  |@                                                   |
 14      1.05    20.18  |*+                                                  |
 15      0.70     7.58  |*+                                                  |
 16      0.29     1.68  |@                                                   |
 17      0.26     8.42  |*+                                                  |
 18      0.10     4.70  |@                                                   |
 19      0.09    12.83  |*+                                                  |
```



osnum	osyr	kit_dims	inst_cac	Fitted	Residual
10.00	77.00	138240.00	235.00	188.73	46.27
1.00	77.00	74088.00	55.10	101.15	-46.05
53.00	72.00	62208.00	44.30	84.93	-40.63
22.00	78.00	24192.00	14.60	33.03	-18.43
53.00	72.00	6500.00	0.40	8.87	-8.47
22.00	78.00	5184.00	3.40	7.08	-3.68
62.00	82.00	4500.00	4.00	6.14	-2.14
62.00	82.00	4096.00	17.00	5.59	11.41
53.00	72.00	3888.00	4.00	5.31	-1.31
53.00	72.00	3024.00	10.90	4.13	6.77
5.00	75.00	2250.00	6.47	3.07	3.40
10.00	77.00	1152.00	2.00	1.57	0.43
101.00	83.00	1056.00	2.40	1.44	0.96
53.00	72.00	768.00	1.60	1.05	0.55
1.00	77.00	512.00	0.90	0.70	0.20
18.00	80.00	216.00	0.51	0.29	0.22
1.00	77.00	192.00	1.00	0.26	0.74
18.00	80.00	72.00	1.42	0.10	1.32
5.00	75.00	64.00	0.57	0.09	0.48

OLS -- DEPENDENT VARIABLE: inst_cac

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1	kit_cac	0.252395864	(0.03632)	T= 6.94934	0.000
2	Constant	5.719094931	(2.19809)	T= 2.60185	0.029

SAMPLE SIZE(1 to 11) =	11 (DF=9)
SUM OF SQUARED RESIDUALS =	409.517036
VARIANCE (MSE) =	45.501893
STANDARD ERROR (ROOT MSE) =	6.745509
R-SQUARED =	0.842914
ADJUSTED R-SQUARED =	0.825460
F-STATISTIC(1, 9) =	48.293309 (p=0.0098)
SUM OF RESIDUALS =	0.000000
DURBIN-WATSON STATISTIC =	1.670023

Source	SUM SQ	DF	MEAN SQ
Due to Regression	2606.954	1	2606.954
Residual	409.517	9	45.502
Total	3016.471	10	301.647

[END]

Residual Plot

```
seq.    x58    Min.= -5.35        Mean=0.00          12.70= Max.
        (*)  -+----+----+---M0----+----+-----+----+----+----+----+-
 1     -1.00 |           *  .                                    |
 2      5.62 |              .                *                   |
 3     12.70 |              .                                   *|
 4     -1.19 |           *  .                                    |
 5     -4.83 | *            .                                    |
 6      9.79 |              .                          *         |
 7     -3.01 |     *        .                                    |
 8     -2.85 |      *       .                                    |
 9     -5.17 |*             .                                    |
10     -5.35 |*             .                                    |
11     -4.72 |  *           .                                    |
```

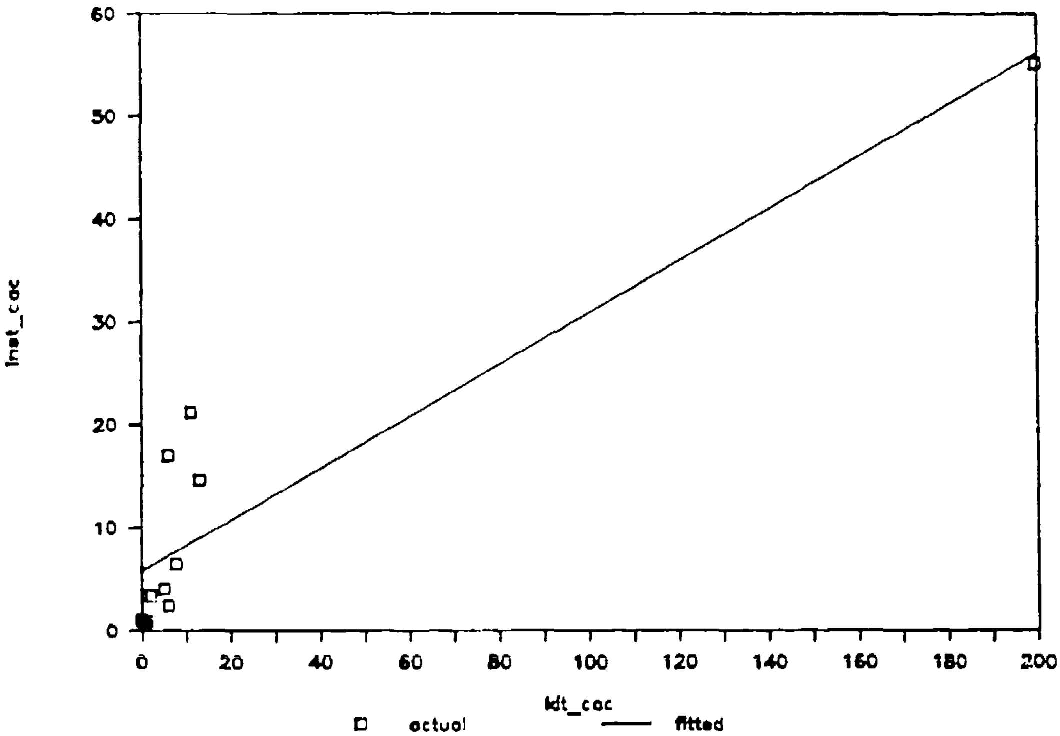
Standard Plot

```
seq.   Fitted inst_cac  Min.=  0.57                       56.10= Max.
        (*)      (+)  -+----+----+----+----+----+----+----+----+----+----+-
  1    56.10    55.10  |                                                +* |
  2     8.98    14.60  |       *    +                                      |
  3     8.50    21.20  |      *           +                                |
  4     7.66     6.47  |    +*                                             |
  5     7.23     2.40  | +   *                                             |
  6     7.21    17.00  |     *        +                                    |
  7     7.01     4.00  |  +  *                                             |
  8     6.25     3.40  |  + *                                              |
  9     6.07     0.90  |+   *                                              |
 10     5.92     0.57  |+   *                                              |
 11     5.72     1.00  |+   *                                              |
```

osnum	osyr	kit_cac	inst_cac	Fitted	Residual
1.00	77.00	199.60	55.10	56.10	-1.00
22.00	78.00	12.90	14.60	8.98	5.62
62.00	82.00	11.00	21.20	8.50	12.70
5.00	75.00	7.70	6.47	7.66	-1.19
101.00	83.00	6.00	2.40	7.23	-4.83
62.00	82.00	5.90	17.00	7.21	9.79
62.00	82.00	5.10	4.00	7.01	-3.01
22.00	78.00	2.10	3.40	6.25	-2.85
1.00	77.00	1.40	0.90	6.07	-5.17
5.00	75.00	0.80	0.57	5.92	-5.35
1.00	77.00	0.00	1.00	5.72	-4.72

[redacted]

Ref. #



60
50
40
30
20
10
0
inst_cac
0
20
40
60
80
100
120
140
160
180
200
kdt_cac
actual
fitted

OLS -- DEPENDENT VARIABLE: INSCAC

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 KITCAC	0.904907261	(0.09280)	T= 9.75156	0.000

```
SAMPLE SIZE(  1 to   10) =          10        (DF=9)
SUM OF SQUARED RESIDUALS =           4.203271
           VARIANCE (MSE) =          0.467030
STANDARD ERROR (ROOT MSE) =          0.683396
                R-SQUARED =          0.782754
       ADJUSTED R-SQUARED =          0.758615
  F-STATISTIC(  1,     9) =         95.092845 (p=0.0038)
        SUM OF RESIDUALS =           0.663114
  DURBIN-WATSON STATISTIC =          1.423065
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	48.614	1	48.614
Residual	4.203	9	0.467
Total	52.818	10	5.282

[END]

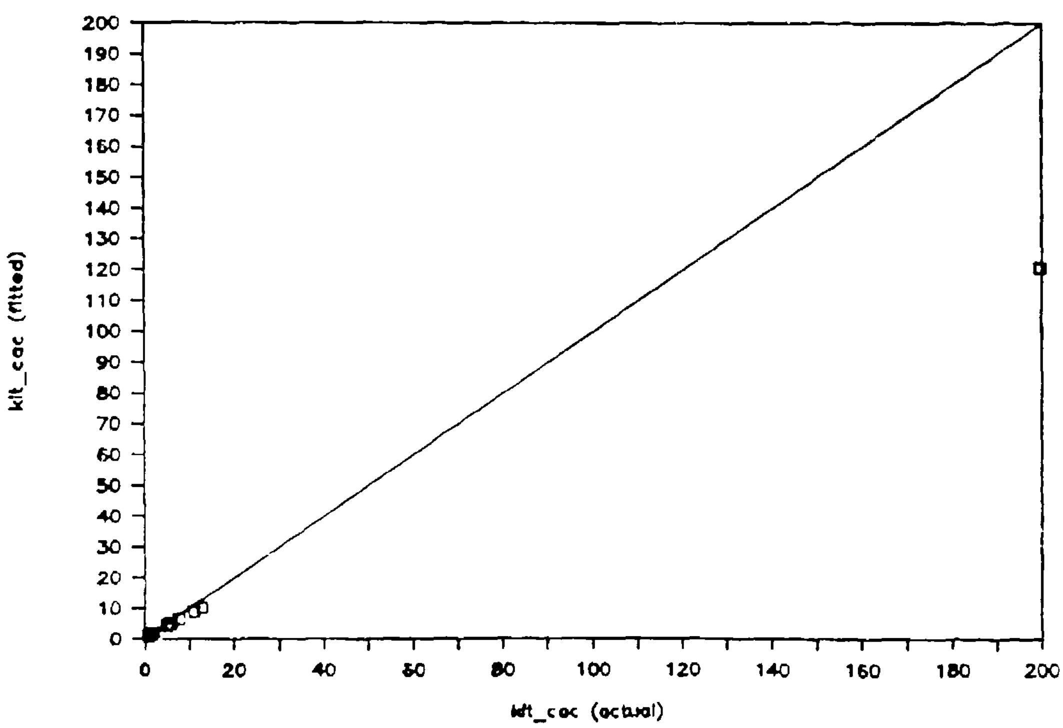
Standard Plot

```
seq. residual  Min.=-65.52       Mean=-3.87       12.44= Max.
          (*)  -+----+----+----+----+----+----+----+---M+-0--+----+-
  1    -65.52  |*                                          .       |
  2     12.44  |                                           .      *|
  3     12.02  |                                           .      *|
  4      4.48  |                                           .  *    |
  5      0.13  |                                           *       |
  6     -0.37  |                                           *       |
  7      1.44  |                                           .*      |
  8     -2.60  |                                         * .       |
  9     -0.46  |                                           *       |
 10     -0.25  |                                           *       |
```

Standard Plot

```
seq. fitted   inst_cac  Min.=  0.57                          120.62= Max.
      (*)       (+)    -+----+----+----+----+----+----+----+----+----+----+-
 1    120.62    55.10  |                        +                           *|
 2      8.76    21.20  |    *     +                                          |
 3      4.98    17.00  |   *    +                                            |
 4     10.12    14.60  |     * +                                             |
 5      6.34     6.47  |   @                                                 |
 6      4.37     4.00  |  +*                                                 |
 7      1.96     3.40  |  @                                                  |
 8      5.06     2.40  |  +*                                                 |
 9      1.36     0.90  |@                                                    |
10      0.82     0.57  |@                                                    |
```

osnum	osyr	INSCAC	KITCAC	inst_cac	kit_cac	fitted	residual
1.00	77.00	4.01	5.30	55.10	199.60	120.62	-65.52
62.00	82.00	3.05	2.40	21.20	11.00	8.76	12.44
62.00	82.00	2.83	1.77	17.00	5.90	4.98	12.02
22.00	78.00	2.68	2.56	14.60	12.90	10.12	4.48
5.00	75.00	1.87	2.04	6.47	7.70	6.34	0.13
62.00	82.00	1.39	1.63	4.00	5.10	4.37	-0.37
22.00	78.00	1.22	0.74	3.40	2.10	1.96	1.44
101.00	83.00	0.88	1.79	2.40	6.00	5.06	-2.66
1.00	77.00	-0.11	0.34	0.90	1.40	1.36	-0.46
5.00	75.00	-0.56	-0.22	0.57	0.80	0.82	-0.25



Ref. #22

OLS -- DEPENDENT VARIABLE: INSTCAC

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1 KITCAC	1.063389132	(0.11830)	T= 8.98879	0.000

```
SAMPLE SIZE(  2 to   10) =          9        (DF=8)
SUM OF SQUARED RESIDUALS =          2.931693
          VARIANCE (MSE) =          0.366462
STANDARD ERROR (ROOT MSE) =         0.605361
               R-SQUARED =          0.786759
      ADJUSTED R-SQUARED =          0.760103
  F-STATISTIC(  1,    8) =         80.798403 (p=0.0000)
        SUM OF RESIDUALS =         -0.621164
 DURBIN-WATSON STATISTIC =          2.893134
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	32.541	1	32.541
Residual	2.932	8	0.366
Total	35.473	9	3.941

[END]

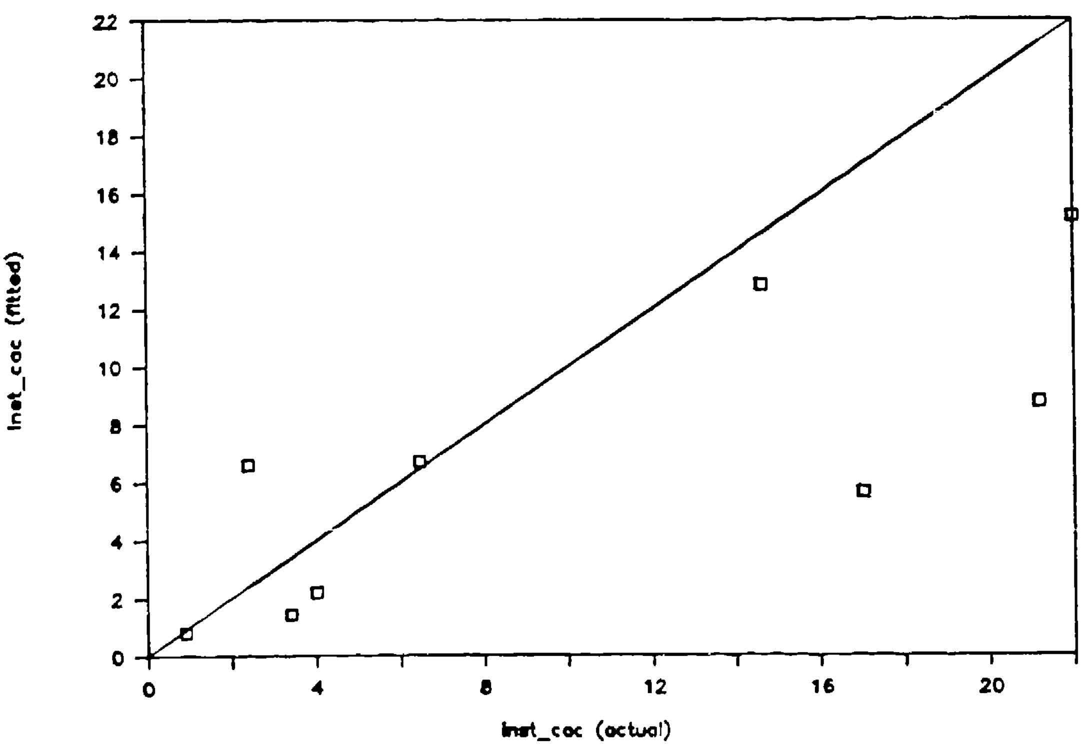
Standard Plot

```
seq. residual  Min.= -4.32        Mean=1.16        10.40= Max.
         (*)  -+----+----+----0--M-+----+----+----+----+----+-
  2     -0.57 |               * .                             |
  3      8.39 |                 .                      *      |
  4     -2.29 |         *       .                             |
  5     -4.32 |*                .                             |
  6     10.40 |                 .                            *|
  7     -1.65 |            *    .                             |
  8      1.20 |                 .   *                         |
  9     -0.53 |               * .                             |
 10     -0.22 |                *.                             |
```

Standard Plot

```
seq. fitted   inst_cac  Min.=  0.57                              21.20= Max.
         (*)       (+)    -+----+-----+----+----+----+-----+----+----+-----+----+-
   2     15.17      14.60  ¦                                    +*                ¦
   3     12.81      21.20  ¦                                *                    +¦
   4      8.76       6.47  ¦               +     *                                ¦
   5      6.72       2.40  ¦    +           *                                     ¦
   6      6.60      17.00  ¦                *                         +           ¦
   7      5.65       4.00  ¦         +   *                                        ¦
   8      2.20       3.40  ¦    *   +                                             ¦
   9      1.43       0.90  ¦ +*                                                   ¦
  10      0.79       0.57  ¦+*                                                    ¦
```

osnum	osyr	kit_cac	inst_cac	fitted	residual
22.00	78.00	12.90	14.60	15.19	-0.59
62.00	82.00	11.00	21.20	12.82	8.38
5.00	75.00	7.70	6.47	8.77	-2.30
101.00	83.00	6.00	2.40	6.73	-4.33
62.00	82.00	5.90	17.00	6.61	10.39
62.00	82.00	5.10	4.00	5.66	-1.66
22.00	78.00	2.10	3.40	2.20	1.20
1.00	77.00	1.40	0.90	1.43	-0.53
5.00	75.00	0.80	0.57	0.79	-0.22



OLS -- DEPENDENT VARIABLE: mhrs_100

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB
1	hw_cac	0.781046379	(0.50688)	T= 1.54090	0.15
2	aveq_wt	0.068914563	(0.01756)	T= 3.92486	0.00

```
SAMPLE SIZE( 46 to   58) =          13        (DF=11)
 SUM OF SQUARED RESIDUALS =   184957.571532
           VARIANCE (MSE) =    16814.324685
STANDARD ERROR (ROOT MSE) =      129.670061
                R-SQUARED =        0.830967
       ADJUSTED R-SQUARED =        0.800234
  F-STATISTIC(  2,    11) =       36.115540 (p=0.0000)
         SUM OF RESIDUALS =     -439.742049
  DURBIN-WATSON STATISTIC =        1.695942
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.399E+006	2	6.997E+005
Residual	1.850E+005	11	16814.325
Total	1.584E+006	13	1.219E+005

[END]

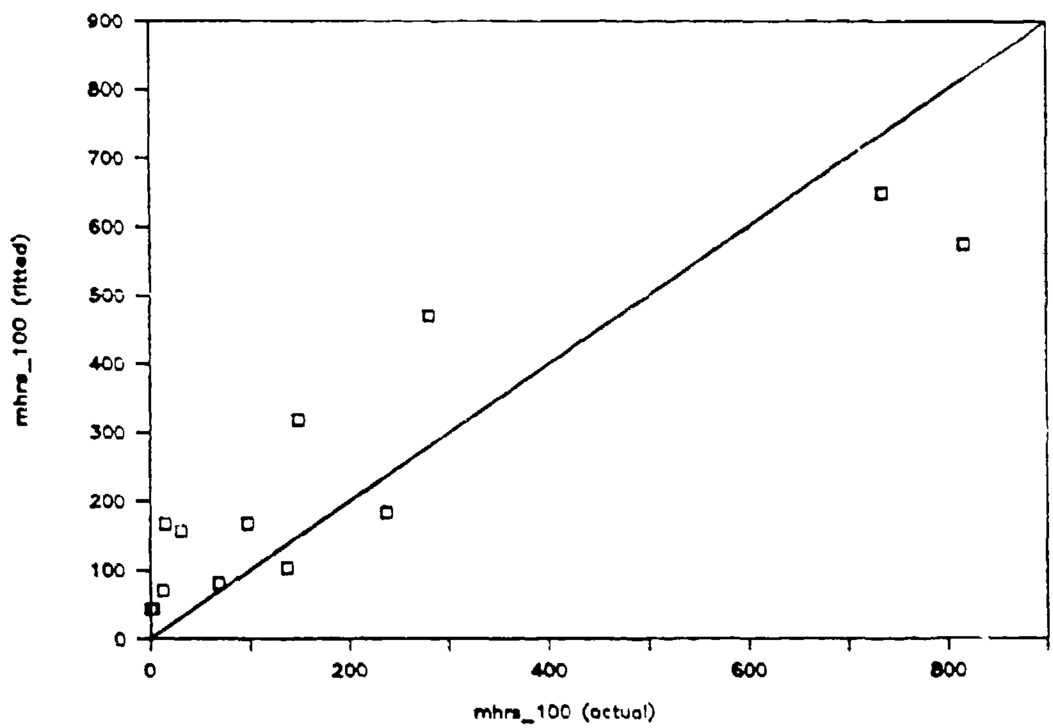
Residual Plot

```
seq.    x63    Min.=-190.02     Mean=-33.83      241.97= Max.
         (*)  -+----+----+----+--M-+-0--+----+----+----+----+-
 46    85.73  |                          .         *                  |
 47   241.97  |                          .                           *|
 48  -190.02  |*                         .                            |
 49  -169.02  |  *                       .                            |
 50    53.52  |                          .     *                      |
 51   -70.22  |              *           .                            |
 52  -151.66  |    *                     .                            |
 53  -125.55  |       *                  .                            |
 54    34.41  |                          .    *                       |
 55   -10.99  |                         *.                            |
 56   -56.80  |               *          .                            |
 57   -39.35  |                 *        .                            |
 58   -41.79  |                 *        .                            |
```

Standard Plot

```
seq.    Fitted mhrs_100  Min.=  1.14                                  817.00= Max.
          (*)      (+)  -+--------+--------+--------+--------+--------+--------+--------+--------+--------+--------+-
  46    649.27   735.00 |                                                                         *        +         |
  47    575.03   817.00 |                                                                *                          +|
  48    470.37   280.35 |                               +                     *                                      |
  49    318.02   149.00 |                +                  *                                                        |
  50    183.48   237.00 |                    *     +                                                                 |
  51    167.72    97.50 |           +      *                                                                         |
  52    166.69    15.03 |  +               *                                                                         |
  53    156.76    31.21 |    +             *                                                                         |
  54    103.81   138.22 |           *   +                                                                            |
  55     80.29    69.30 |        +*                                                                                  |
  56     69.63    12.83 |  +     *                                                                                   |
  57     43.21     3.86 |+     *                                                                                     |
  58     42.93     1.14 |+     *                                                                                     |
```

osnum	osyr	hw_cac	aveq_wt	mhrs_100	Fitted	Residual
104.00	79.00	262.00	6452.00	735.00	649.27	85.73
47.00	81.00	159.00	6542.00	817.00	575.03	241.97
47.00	81.00	25.00	6542.00	280.35	470.37	-190.02
62.00	82.00	197.00	2382.00	149.00	318.02	-169.02
26.00	79.00	133.00	1155.00	237.00	183.48	53.52
60.00	82.00	50.00	1867.00	97.50	167.72	-70.22
117.00	84.00	79.00	1523.40	15.03	166.69	-151.66
15.00	80.00	98.79	1155.00	31.21	156.76	-125.55
5.00	75.00	31.00	1155.00	138.22	103.81	34.41
4.24	82.00	3.58	757.00	69.30	80.29	-10.99
5.00	75.00	19.00	795.00	12.83	69.63	-56.80
21.00	82.00	21.00	389.00	3.86	43.21	-39.35
6.00	83.00	21.00	385.00	1.14	42.93	-41.79


900
800
700
600
500
400
300
200
100
0
mhrs_100 (fitted)
0
200
400
600
800
mhrs_100 (actual)

OLS -- DEPENDENT VARIABLE: MHRS_100

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB
1 UWTIN	0.800467486	(0.24945)	T= 3.20890	0.00
2 WIRCH+1	5.529238671	(1.15200)	T= 4.79968	0.00
3 Constant	-5.388408137	(1.60187)	T= -3.36383	0.00

```
SAMPLE SIZE( 52 to   69) =         17         (DF=14)
SUM OF SQUARED RESIDUALS =         10.944622
          VARIANCE (MSE) =          0.781759
STANDARD ERROR (ROOT MSE) =         0.884171
               R-SQUARED =          0.747342
      ADJUSTED R-SQUARED =          0.711248
 F-STATISTIC(  2,    14) =         20.705481 (p=0.0001)
      SUM OF RESIDUALS =           -0.000000
 DURBIN-WATSON STATISTIC =          1.650963
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	43.318	2	21.659
Residual	10.945	14	0.782
Total	54.263	16	3.391

[END

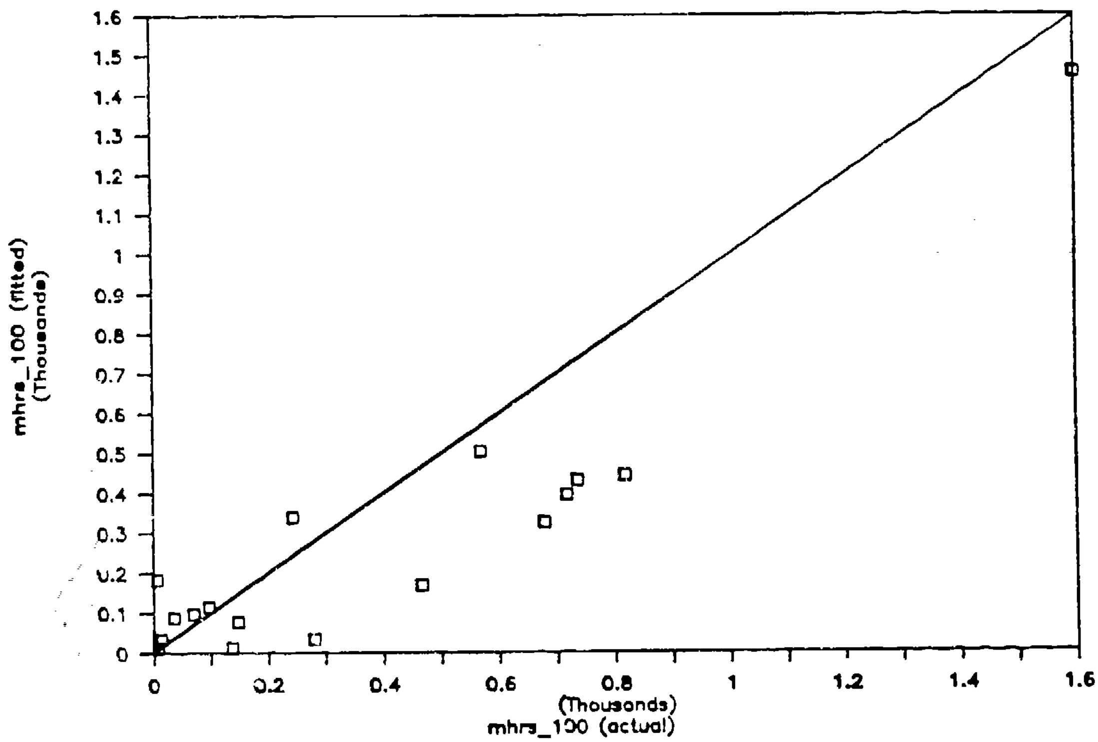
Standard Plot

```
seq. residual  Min.=-888.54      Mean=28.01        339.46= Max.
         (*)  -+----+----+----+----+----+----+----+0M--+----+----+-
 52   313.24  |                                    .           *  |
 53   292.17  |                                    .          *   |
 54   285.55  |                                    .          *   |
 55   339.46  |                                    .             *|
 56  -888.54  |*                                   .              |
 57   141.22  |                                    .     *        |
 58   203.61  |                                    .       *      |
 59  -149.46  |                              *     .              |
 60    61.25  |                                    .  *           |
 61   107.92  |                                    .    *         |
 62   -86.26  |                                 *  .              |
 63   -43.29  |                                  * .              |
 64   -59.00  |                                  * .              |
 65   -18.77  |                                   *.              |
 66     3.39  |                                    *              |
 67    -2.36  |                                    *              |
 68   -24.02  |                                   *.              |
```

Standard Plot

```
eq. fitted   mhrs_100  Min.=  1.17                    1455.70= Max.
       (*)        (+) -+----+----+----+----+----+----+----+----+----+----+-
 52   503.76   817.00 |                 *          +                       |
 53   442.83   735.00 |               *          +                         |
 54   430.70   716.25 |               *          +                         |
 55   339.00   678.46 |            *          +                            |
 56  1455.70   567.16 |                   +                              * |
 57   324.10   465.32 |           *    +                                   |
 58    76.74   280.35 |   *      +                                         |
 59   393.76   244.30 |        +    *                                      |
 60    87.75   149.00 |   * +                                              |
 61    30.30   138.22 | *   +                                              |
 62   183.76    97.50 |   +  *                                             |
 63   114.01    70.72 |  + *                                               |
 64    96.72    37.72 | + *                                                |
 65    33.80    15.03 |+*                                                  |
 66    10.52    13.91 |@                                                   |
 67    11.30     8.94 |@                                                   |
 68    32.10     8.08 |+*                                                  |
 69               1.17 |+                                                  |
```

osnum	osyr	uwt_ins	wir_chge	mhrs_100	fitted	residual
47.00	81.00	141.10	3.00	817.00	503.76	313.24
104.00	79.00	120.10	3.00	735.00	442.83	292.17
10.00	77.00	116.00	3.00	716.25	430.70	285.55
8.00	78.00	86.00	3.00	678.46	339.00	339.46
53.00	72.00	531.60	3.00	567.16	1455.70	-888.54
1.00	77.00	81.30	3.00	465.32	324.10	141.22
47.00	81.00	98.10	2.00	280.35	76.74	203.61
71.00	82.00	103.70	3.00	244.30	393.76	-149.46
62.00	82.00	116.00	2.00	149.00	87.75	61.25
5.00	75.00	30.70	2.00	138.22	30.30	107.92
60.00	82.00	40.00	3.00	97.50	183.76	-86.26
100.00	81.00	160.90	2.00	70.72	114.01	-43.29
100.00	81.00	131.00	2.00	37.72	96.72	-59.00
117.00	84.00	35.20	2.00	15.03	33.80	-18.77
7.00	72.00	135.00	1.00	13.91	10.52	3.39
7.00	72.00	8.95	2.00	8.94	11.30	-2.36
48.00	74.00	33.00	2.00	8.08	32.10	-24.02


mhrs_100 (fitted)
(Thousands)
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
(Thousands)
mhrs_100 (actual)

```
                    OLS  -- DEPENDENT VARIABLE: mhrs_100

  RIGHT-HAND            ESTIMATED          STANDARD          T_STATISTIC       PROB.
   VARIABLE            COEFFICIENT          ERROR

 1    hw_cac          0.650319983   (      0.22636)   T=     2.87290       0.017
 2  cmplx          1359.417196884   (    134.26091)   T=    10.12519       0.000

 SAMPLE SIZE( 46 to   57) =           12          (DF=10)
 SUM OF SQUARED RESIDUALS =     39436.648293
           VARIANCE (MSE) =      3943.664829
STANDARD ERROR (ROOT MSE) =        62.798605
                R-SQUARED =         0.957225
       ADJUSTED R-SQUARED =         0.948670
  F-STATISTIC(  2,    10) =       171.824347 (p=0.0000)
        SUM OF RESIDUALS =       136.453101
  DURBIN-WATSON STATISTIC =         2.451147
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.395E+006	2	6.973E+005
Residual	39436.648	10	3943.665
Total	1.434E+006	12	1.195E+005

[END]

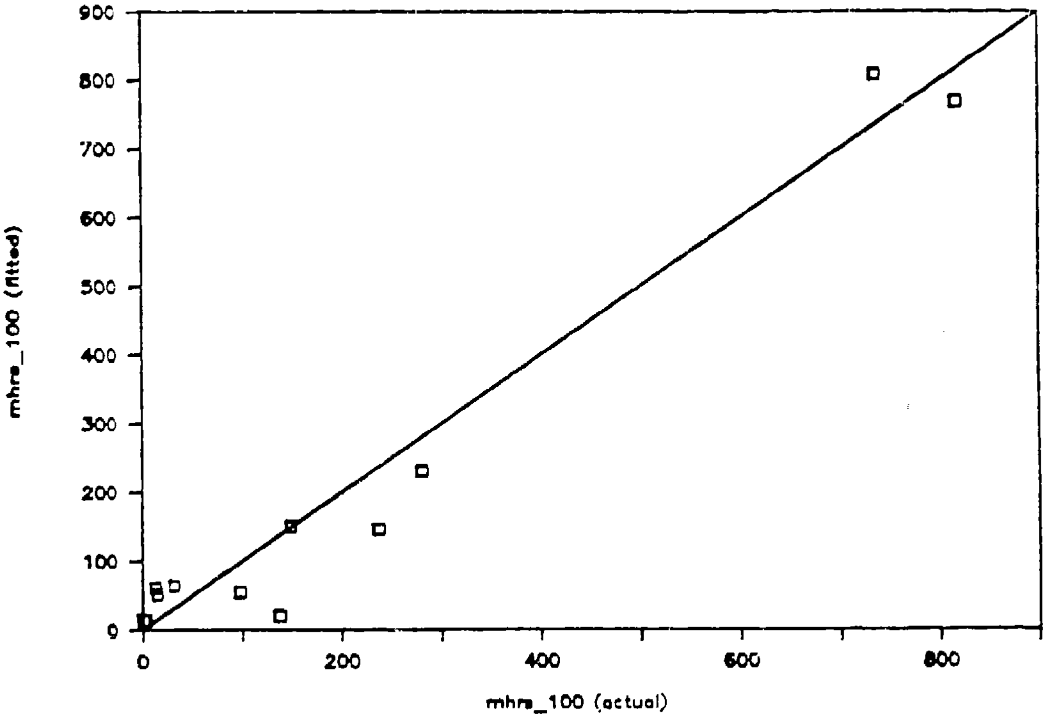
Residual Plot

```
seq.     x62   Min.=-73.40       Mean=11.37       118.06= Max.
         (*)  -+----+----+----+---0+-M--+----+----+----+----+-
 46   -73.40  |*                  .                            |
 47    48.41  |                   .         *                  |
 48    49.96  |                   .         *                  |
 49    -0.92  |                   *                            |
 50    91.59  |                   .                    *       |
 51   -33.04  |           *       .                            |
 52   -48.60  |      *            .                            |
 53    43.06  |                   .       *                    |
 54   -36.35  |          *        .                            |
 55   118.06  |                   .                           *|
 56    -9.80  |                 * .                            |
 57   -12.52  |                *  .                            |
```

Standard Plot

```
seq.   Fitted mhrs_100  Min.=  1.14                                   817.00= Max.
          (*)     (+)  -+----+----+----+----+----+----+----+----+----+----+-
 46    808.40  735.00 |                                                  +   * |
 47    768.59  817.00 |                                                    *  +|
 48    230.39  280.35 |               *   +                                    |
 49    149.92  149.00 |          @                                             |
 50    145.41  237.00 |          *    +                                        |
 51     64.25   31.21 |  + *                                                   |
 52     61.43   12.83 | +   *                                                  |
 53     54.44   97.50 |   *   +                                                |
 54     51.38   15.03 | + *                                                    |
 55     20.16  138.22 | *       +                                              |
 56     13.66    3.86 |+*                                                      |
 57     13.66    1.14 |+*                                                      |
```

osnum	osyr	hw_cac	cmplx	mhrs_100	Fitted	Residual
104.00	79.00	262.00	0.47	735.00	808.40	-73.40
47.00	81.00	159.00	0.49	817.00	768.59	48.41
47.00	81.00	25.00	0.16	280.35	230.39	49.96
62.00	82.00	197.00	0.02	149.00	149.92	-0.92
26.00	79.00	133.00	0.04	237.00	145.41	91.59
15.00	80.00	98.79	0.00	31.21	64.25	-33.04
5.00	75.00	19.00	0.04	12.83	61.43	-48.60
60.00	82.00	50.00	0.02	97.50	54.44	43.06
117.00	84.00	79.00	0.00	15.03	51.38	-36.35
5.00	75.00	31.00	0.00	138.22	20.16	118.06
21.00	82.00	21.00	0.00	3.86	13.66	-9.80
6.00	83.00	21.00	0.00	1.14	13.66	-12.52


900
800
700
600
500
400
300
200
100
0
mhrs_100 (fitted)
0
200
400
600
800
mhrs_100 (actual)

OLS -- DEPENDENT VARIABLE: mhrs_100

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PRO
1 hw_cac	0.756666244	(0.23203)	T= 3.26100	0.0
2 othin	4.165277671	(0.43774)	T= 9.51550	0.0

```
  SAMPLE SIZE( 46 to   57) =          12       (DF=10)
  SUM OF SQUARED RESIDUALS =       44133.503771
          VARIANCE (MSE) =         4413.350377
STANDARD ERROR (ROOT MSE) =          66.433052
                R-SQUARED =           0.949927
       ADJUSTED R-SQUARED =           0.939912
   F-STATISTIC(  2,    10) =         153.006027 (p=0.0000)
        SUM OF RESIDUALS =           75.780654
  DURBIN-WATSON STATISTIC =           2.792893
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.395E+006	2	6.973E+005
Residual	44133.504	10	4413.350
Total	1.439E+006	12	1.199E+005

[EN

Residual Plot

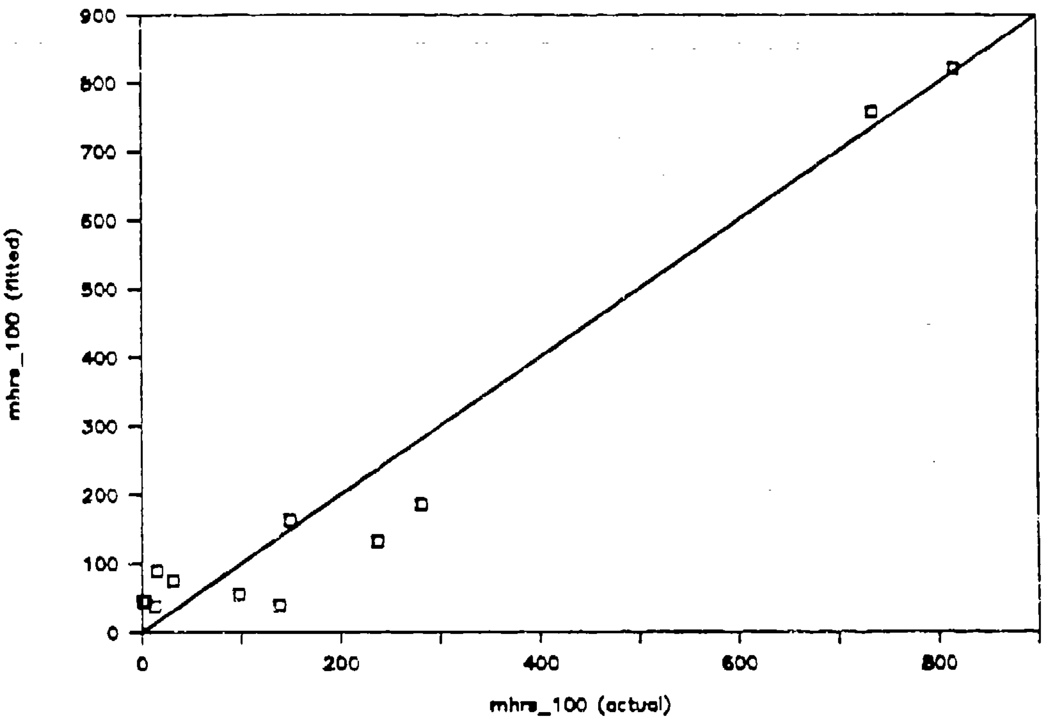
```
seq.    x60   Min.=-73.90     Mean=6.32       105.12= Max.
         (*) -+----+----+----+----+0M--+----+----+----+----+----+-
 46    -4.33 ¦                   * .                             ¦
 47   -23.06 ¦              *      .                             ¦
 48    94.82 ¦                     .                         *   ¦
 49   -12.56 ¦                 *   .                             ¦
 50   105.12 ¦                     .                            *¦
 51   -73.90 ¦*                    .                             ¦
 52   -43.54 ¦        *            .                             ¦
 53    43.01 ¦                     .           *                 ¦
 54   -41.19 ¦         *           .                             ¦
 55   -43.91 ¦        *            .                             ¦
 56    99.77 ¦                     .                           * ¦
 57   -24.46 ¦              *      .                             ¦
```

Ref. #26

Standard Plot

```
seq.   Fitted mhrs_100 Min.=  1.14                       821.33= Max.
          (*)      (+) -+----+----+----+----+----+----+----+----+----+----+-
  46   821.33   817.00  |                                                 @|
  47   758.06   735.00  |                                            +*    |
  48   185.53   280.35  |           *     +                                |
  49   161.56   149.00  |        +*                                        |
  50   131.88   237.00  |        *     +                                   |
  51    88.93    15.03  | +   *                                            |
  52    74.75    31.21  |  + *                                             |
  53    54.49    97.50  |   *  +                                           |
  54    45.05     3.86  |+  *                                              |
  55    45.05     1.14  |+  *                                              |
  56    38.45   138.22  |  *     +                                         |
  57    37.29    12.83  | +*                                               |
```

osnum	osyr	othin	hw_cac	mhrs_100	Fitted	Residual
47.00	81.00	168.30	159.00	817.00	821.33	-4.33
104.00	79.00	134.40	262.00	735.00	758.06	-23.06
47.00	81.00	40.00	25.00	280.35	185.53	94.82
62.00	82.00	3.00	197.00	149.00	161.56	-12.56
26.00	79.00	7.50	133.00	237.00	131.88	105.12
117.00	84.00	7.00	79.00	15.03	88.93	-73.90
15.00	80.00	0.00	98.79	31.21	74.75	-43.54
60.00	82.00	4.00	50.00	97.50	54.49	43.01
21.00	82.00	7.00	21.00	3.86	45.05	-41.19
6.00	83.00	7.00	21.00	1.14	45.05	-43.91
5.00	75.00	3.60	31.00	138.22	38.45	99.77
5.00	75.00	5.50	19.00	12.83	37.29	-24.46


mhrs_100 (fitted)
mhrs_100 (actual)
900
800
700
600
500
400
300
200
100
0
0
200
400
600
800

OLS -- DEPENDENT VARIABLE: mhrs_100

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB.
1	hw_cac	0.829954267	(0.27004)	T= 3.07347	0.013
2	cabin	4.379863949	(0.90432)	T= 4.84329	0.001
3	cabrem	0.923762569	(0.29141)	T= 3.16993	0.011

```
       SAMPLE SIZE( 46 to   57) =        12         (DF=9)
       SUM OF SQUARED RESIDUALS =   49113.582899
                 VARIANCE (MSE) =    5457.064767
   STANDARD ERROR (ROOT MSE) =        73.871948
                      R-SQUARED =         0.948461
             ADJUSTED R-SQUARED =         0.931282
      F-STATISTIC(  3,      9) =        82.190603 (p=0.0010)
            SUM OF RESIDUALS =       188.674689
     DURBIN-WATSON STATISTIC =         1.597201
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.395E+006	3	4.649E+005
Residual	49113.583	9	5457.065
Total	1.444E+006	12	1.203E+005

[END]

Residual Plot

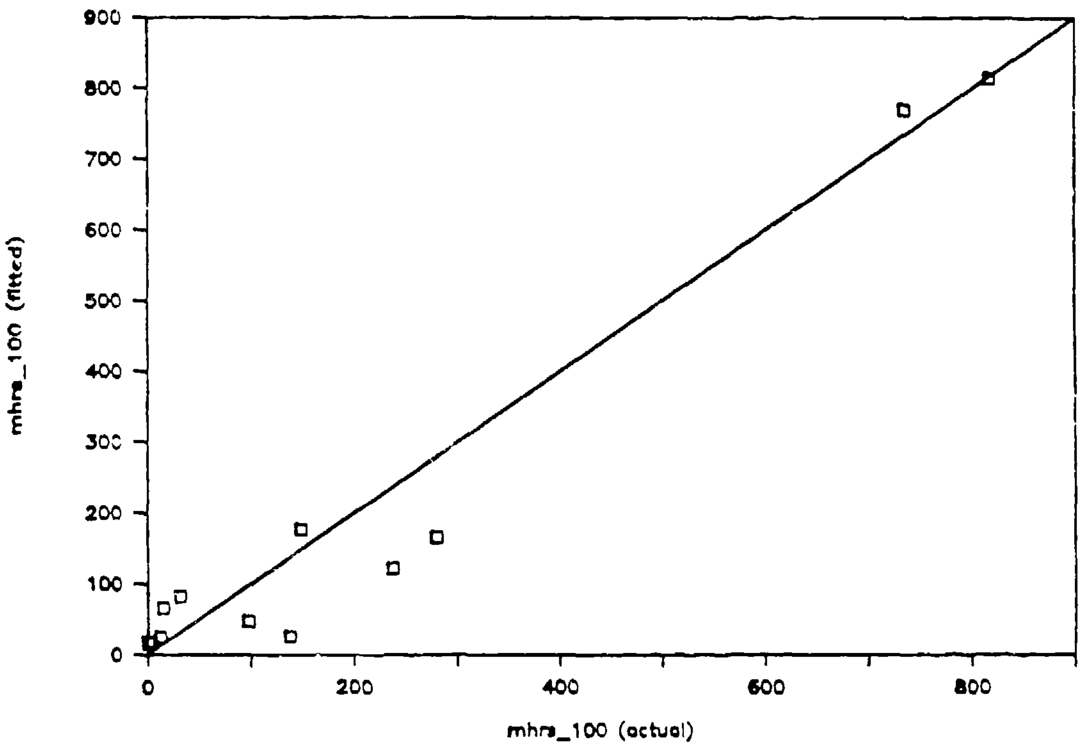
```
seq.     x58    Min.=-50.78       Mean=15.72       114.79= Max.
         (*) -+----+----+----0----M----+----+----+----+----+----+-
 46     2.54 |               .*                               |
 47   -35.26 |     *         .                                |
 48   -27.64 |       *       .                                |
 49   113.93 |               .                               *|
 50   114.79 |               .                               *|
 51   -50.78 |*              .                                |
 52   -50.54 |*              .                                |
 53    50.70 |               .               *                |
 54   112.49 |               .                              * |
 55   -11.70 |            *  .                                |
 56   -13.57 |           *   .                                |
 57   -16.29 |          *    .                                |
```

Standard Plot

```
seq.    Fitted mhrs_100 Min.=  1.14                     817.00= Max.
          (*)      (+)  -+----+----+----+----+----+----+----+----+----+----+-
 46     814.46   817.00 |                                                  @|
 47     770.26   735.00 |                                               + * |
 48     176.64   149.00 |         + *                                       |
 49     166.42   280.35 |          *       +                                |
 50     122.21   237.00 |       *       +                                   |
 51      81.99    31.21 |  +  *                                             |
 52      65.57    15.03 | +  *                                              |
 53      46.80    97.50 |   *  +                                            |
 54      25.73   138.22 |  *     +                                          |
 55      24.53    12.83 | @                                                 |
 56      17.43     3.86 |+*                                                 |
 57      17.43     1.14 |+*                                                 |
```

osnum	osyr	cabrem	cabin	hw_cac	mhrs_100	Fitted	Residual
47.00	81.00	339.60	84.20	159.00	817.00	814.46	2.54
104.00	79.00	43.70	117.00	262.00	735.00	770.26	-35.26
62.00	82.00	0.00	3.00	197.00	149.00	176.64	-27.64
47.00	81.00	5.50	32.10	25.00	280.35	166.42	113.93
26.00	79.00	0.00	2.70	133.00	237.00	122.21	114.79
15.00	80.00	0.00	0.00	98.79	31.21	81.99	-50.78
117.00	84.00	0.00	0.00	79.00	15.03	65.57	-50.54
60.00	82.00	1.00	1.00	50.00	97.50	46.80	50.70
5.00	75.00	0.00	0.00	31.00	138.22	25.73	112.49
5.00	75.00	0.00	2.00	19.00	12.83	24.53	-11.70
21.00	82.00	0.00	0.00	21.00	3.86	17.43	-13.57
6.00	83.00	0.00	0.00	21.00	1.14	17.43	-16.29

Ref. #27



mhrs_100 (fitted)
900
800
700
600
500
400
300
200
100
0
0
200
400
600
800
mhrs_100 (actual)

```
                         OLS  -- DEPENDENT VARIA"LE: mhrs_100
  RIGHT-HAND            ESTIMATED        STANDARD        T_STATISTIC      PROB
   VARIABLE            COEFFICIENT         ERROR

  1    hw_cac          0.883232395   (     0.31964)    T=     2.76321     0.02
  2  kit_dims          0.007951035   (     0.00103)    T=     7.74829     0.00

  SAMPLE SIZE( 46 to    54) =            9       (DF=7)
  SUM OF SQUARED RESIDUALS =      38511.158802
             VARIANCE (MSE) =      5501.594115
STANDARD ERROR (ROOT MSE) =         74.172732
                 R-SQUARED =          0.920247
        ADJUSTED R-SQUARED =          0.897461
  F-STATISTIC(  2,     7) =         75.973643  (p=0.0000)
          SUM OF RESIDUALS =         15.331622
  DURBIN-WATSON STATISTIC =          2.000068
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	8.745E+005	2	4.372E+005
Residual	38511.159	7	5501.594
Total	9.130E+005	9	1.014E+005

[END

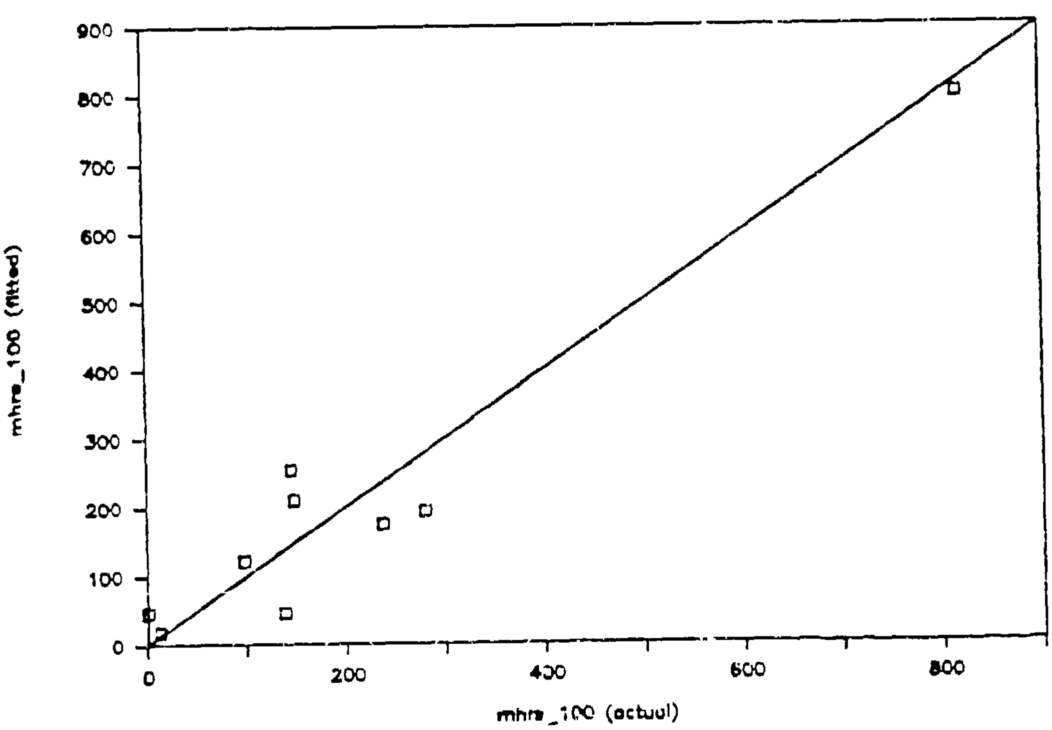
Residual Plot

```
seq.     x60    Min.=-108.60       Mean=1.70        92.95= Max.
         (*)   -+----+----+----+----+----+-M--+----+----+----+----+-
 46     17.08   |                            .    *                 |
 47   -108.60   |*                           .                      |
 48    -60.78   |            *               .                      |
 49     86.53   |                            .                   *  |
 50     62.59   |                            .             *        |
 51    -24.52   |                     *      .                      |
 52    -45.46   |                *           .                      |
 53     92.95   |                            .                     *|
 54     -4.46   |                           *.                      |
```

Standard Plot

```
seq.   Fitted mhrs_100  Min.=  1.14                       817.00= Max.
         (*)     (+)   -+----+----+----+----+----+----+----+----+----+----+-
 46    799.92   817.00 |                                                *+|
 47    254.31   145.71 |         +      *                                 |
 48    209.78   149.00 |         +   *                                    |
 49    193.82   280.35 |            *    +                                |
 50    174.41   237.00 |           *  +                                   |
 51    122.02    97.50 |      +*                                          |
 52     46.60     1.14 |+  *                                              |
 53     45.27   138.22 |   *    +                                         |
 54     17.29    12.83 | @                                                |
```

osnum	osyr	kit_dims	hw_cac	mhrs_100	Fitted	Residual
47.00	81.00	82944.00	159.00	817.00	799.92	17.08
68.00	79.00	30096.00	17.00	145.71	254.31	-108.60
62.00	82.00	4500.00	197.00	149.00	209.78	-60.78
47.00	81.00	21600.00	25.00	280.35	193.82	86.53
26.00	79.00	7161.00	133.00	237.00	174.41	62.59
60.00	82.00	9792.00	50.00	97.50	122.02	-24.52
6.00	83.00	3528.00	21.00	1.14	46.60	-45.46
5.00	75.00	2250.00	31.00	138.22	45.27	92.95
5.00	75.00	64.00	19.00	12.83	17.29	-4.46



[redacted]

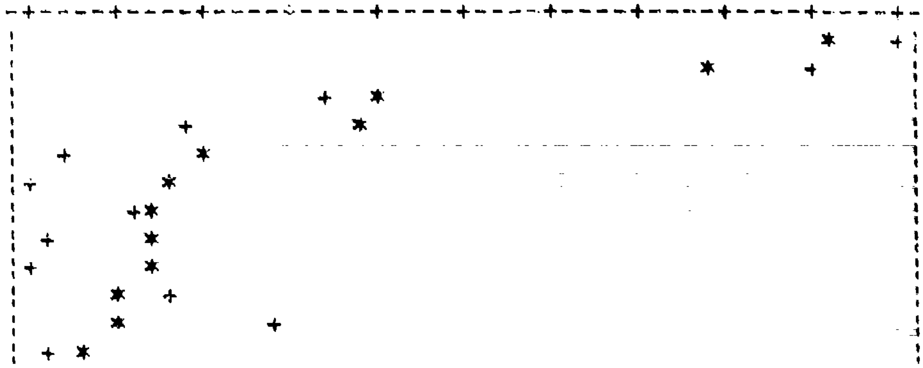
```
                         OLS  -- DEPENDENT VARIABLE: mhrs_100

    RIGHT-HAND            ESTIMATED          STANDARD          T_STATISTIC       PR(
     VARIABLE            COEFFICIENT          ERROR

  1    hw_cac           0.140820637    (       0.51140)    T=      0.27537      0.'
  2   twt_ins           2.353408834    (       0.46302)    T=      5.08276      0.(

  SAMPLE SIZE( 46 to    57) =             12         (DF=10)
  SUM OF SQUARED RESIDUALS =         123830.165795
           VARIANCE (MSE) =          12383.016579
 STANDARD ERROR (ROOT MSE) =           111.279003
                 R-SQUARED =             0.880813
       ADJUSTED R-SQUARED =             0.856975
   F-STATISTIC(  2,     10) =            51.313900 (p=0.0000)
        SUM OF RESIDUALS =           -338.824551
   DURBIN-WATSON STATISTIC =             1.070445

                               Source |   SUM SQ      |  DF  |  MEAN SQ
                    |-----------------|---------------|------|------------|
                    |Due to Regression |   1.395E+006|     2|  6.973E+005|
                    |        Residual |   1.238E+005|    10|   12383.017|
                    |           Total |   1.519E+006|    12|  1.265E+005|
                    |-----------------|---------------|------|------------|
                                                                          [E
```

```
                                  Residual Plot

seq.     x66    Min.=  5.00        Mean=48.00        117.00= Max.
         (*)  -+----+----+----+---M+----+----+---+----+----+----+-
  46   104.00 |                                          *      |
  47    47.00 |                  *                              |
  48    62.00 |                       *                         |
  49    15.00 |    *                                            |
  50     6.00 |*                                                |
  51    60.00 |                       *                         |
  52   117.00 |                                                *|
  53    21.00 |       *                                         |
  54     5.00 |*                                                |
  55    26.00 |         *                                       |
  56     5.00 |*                                                |
  57   108.00 |                                            *    |
```

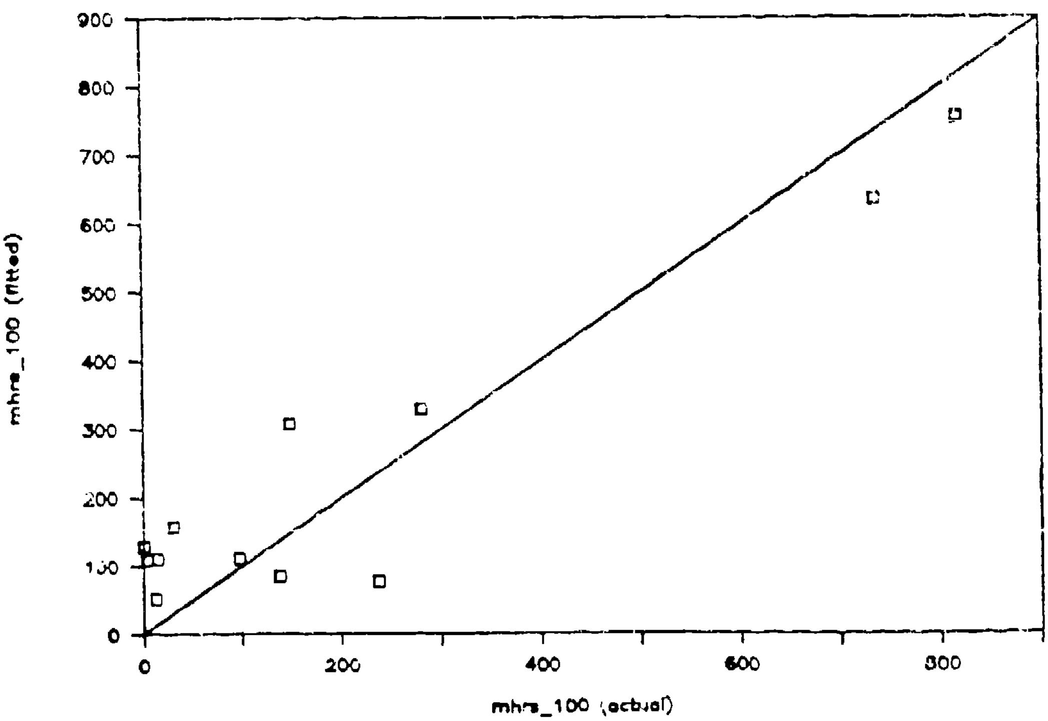
Standard Plot

seq.	Fitted (*)	mhrs_100 (+)
46	755.24	817.00
47	635.84	735.00
48	328.53	280.35
49	307.80	149.00
50	157.47	31.21
51	129.10	1.14
52	110.59	97.50
53	110.44	15.03
54	108.86	3.86
55	85.09	138.22
56	76.62	237.00
57	51.39	12.83

Min.= 1.14 817.00= Max.



osnum	osyr	twt_ins	hw_cac	mhrs_100	Fitted	Residual
47.00	81.00	311.40	159.00	817.00	755.24	61.76
104.00	79.00	254.50	262.00	735.00	635.84	99.16
47.00	81.00	138.10	25.00	280.35	328.53	-48.18
62.00	82.00	119.00	197.00	149.00	307.80	-158.80
15.00	80.00	61.00	98.79	31.21	157.47	-126.26
6.00	83.00	53.60	21.00	1.14	129.10	-127.96
60.00	82.00	44.00	50.00	97.50	110.59	-13.09
117.00	84.00	42.20	79.00	15.03	110.44	-95.41
21.00	82.00	45.00	21.00	3.86	108.86	-105.00
5.00	75.00	34.30	31.00	138.22	85.09	53.13
26.00	79.00	24.60	133.00	237.00	76.62	160.38
5.00	75.00	20.70	19.00	12.83	51.39	-38.56



OLS -- DEPENDENT VARIABLE: mhrs_100

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROB
1 kit_wt	0.974341469	(0.09612)	T= 10.13663	0.0C

SAMPLE SIZE(1 to 35) =	35	(DF=34)
SUM OF SQUARED RESIDUALS =	409972.818221	
VARIANCE (MSE) =	12058.024065	
STANDARD ERROR (ROOT MSE) =	109.809035	
R-SQUARED =	0.722384	
ADJUSTED R-SQUARED =	0.714219	
F-STATISTIC(1, 34) =	102.751177	(p=0.0000)
SUM OF RESIDUALS =	125.588241	
DURBIN-WATSON STATISTIC =	1.441099	

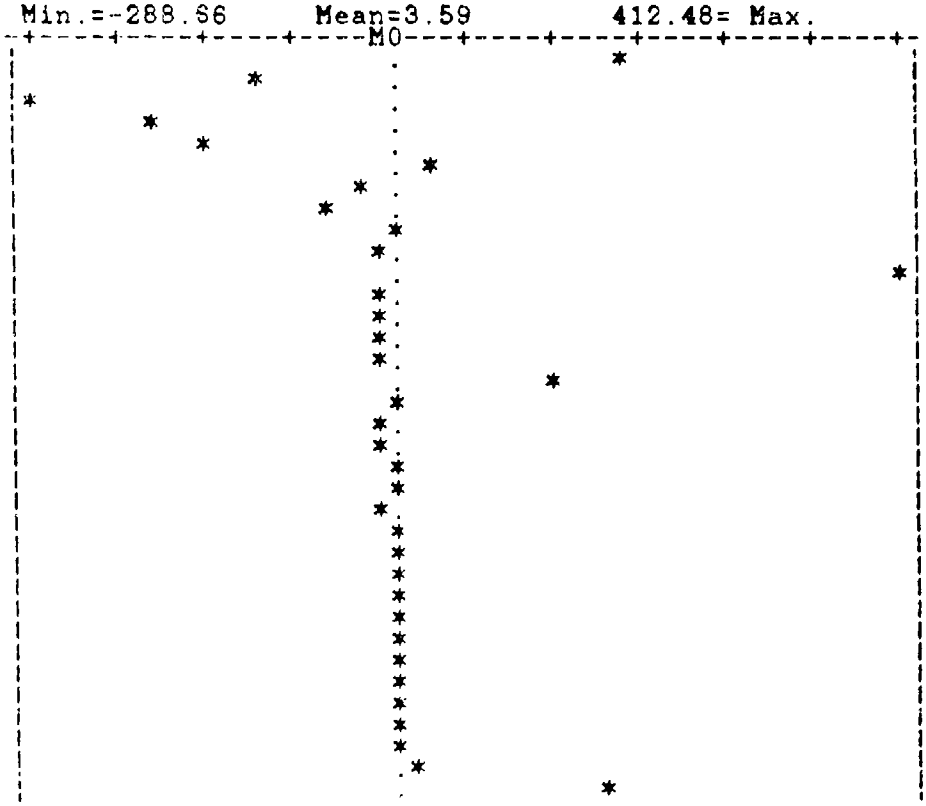
Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.649E+006	1	1.649E+006
Residual	4.100E+005	34	12058.024
Total	2.059E+006	35	58826.337

[EN]

Residual Plot

Min.=-288.66 Mean=3.59 412.48= Max.

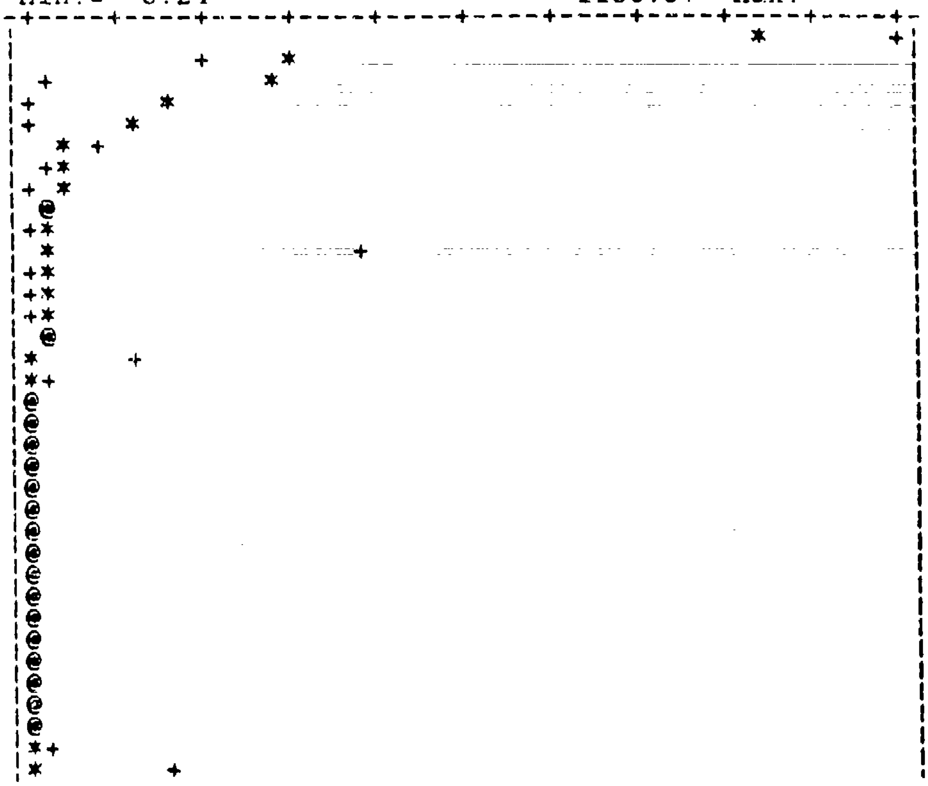
seq.	x58 (*)
1	186.63
2	-112.72
3	-288.66
4	-189.02
5	-143.05
6	32.80
7	-16.67
8	-43.83
9	3.58
10	-13.27
11	412.48
12	-14.59
13	-14.76
14	-14.40
15	-2.01
16	126.20
17	3.01
18	-4.43
19	-2.53
20	0.40
21	-0.55
22	-1.26
23	2.09
24	1.16
25	-0.88
26	1.79
27	0.22
28	0.24
29	0.40
30	3.73
31	4.32
32	7.69
33	0.28
34	21.31
35	177.89

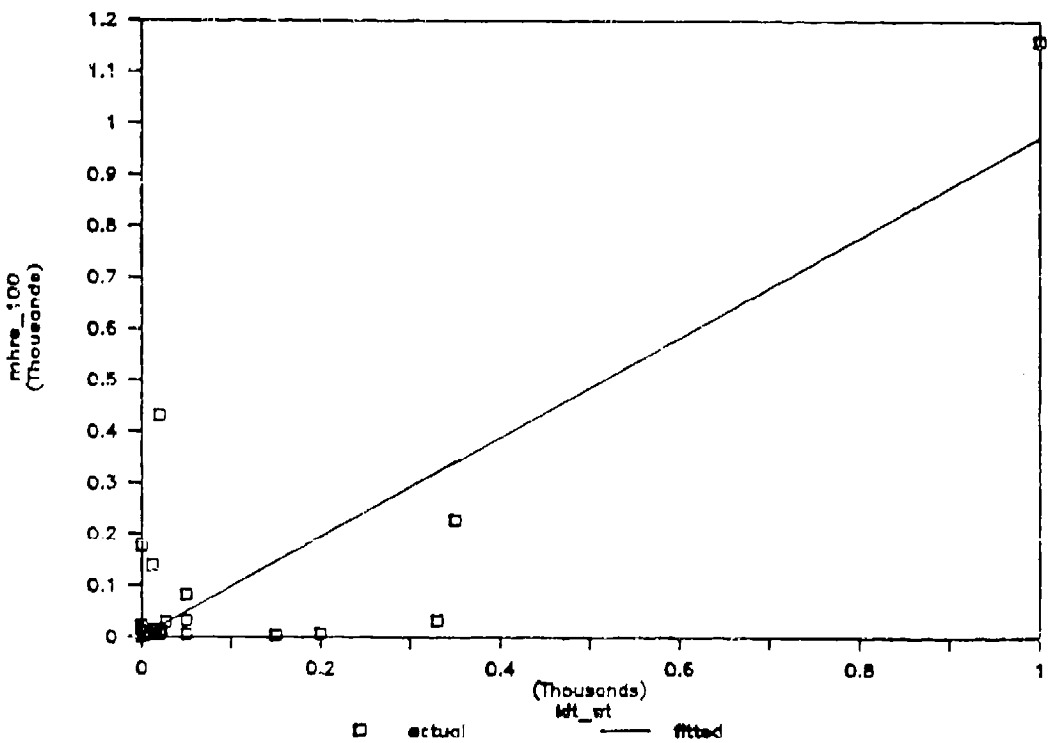


Standard Plot

Min.= 0.24 1160.97= Max.

seq.	Fitted (*)	mhrs_100 (+)
1	974.34	1160.97
2	341.02	228.30
3	321.53	32.87
4	194.87	5.85
5	146.15	3.10
6	48.72	81.52
7	48.72	32.05
8	48.72	4.89
9	26.31	29.89
10	22.41	9.14
11	19.49	431.97
12	19.49	4.90
13	19.49	4.73
14	18.51	4.11
15	14.62	12.61
16	11.69	139.89
17	10.72	13.73
18	10.33	5.90
19	9.74	7.21
20	9.74	10.14
21	3.90	3.35
22	3.90	2.64
23	2.92	5.01
24	2.92	4.08
25	2.44	1.56
26	1.95	3.74
27	1.46	1.68
28	1.46	1.70
29	0.97	1.37
30	0.97	4.70
31	0.97	5.29
32	0.73	8.42
33	0.58	0.86
34	0.49	21.80
35	0.24	178.13





osnum	osyr	kit_wt	mhrs_100	Fitted	Residual
23.00	79.00	1000.00	1160.97	974.34	186.63
49.00	82.00	350.00	228.30	341.02	-112.72
19.00	81.00	330.00	32.87	321.53	-288.66
104.00	79.00	200.00	5.85	194.87	-189.02
104.00	79.00	150.00	3.10	146.15	-143.05
22.00	79.00	50.00	81.52	48.72	32.80
23.00	79.00	50.00	32.05	48.72	-16.67
27.00	70.00	50.00	4.89	48.72	-43.83
22.00	78.00	27.00	29.89	26.31	3.58
104.00	83.00	23.00	9.14	22.41	-13.27
31.00	82.00	20.00	431.97	19.49	412.48
8.00	78.00	20.00	4.90	19.49	-14.59
53.00	72.00	20.00	4.73	19.49	-14.76
51.00	82.00	19.00	4.11	18.51	-14.40
68.00	79.00	15.00	12.61	14.62	-2.01
53.00	72.00	12.00	139.89	11.69	128.20
8.00	78.00	11.00	13.73	10.72	3.01
114.00	83.00	10.60	5.90	10.33	-4.43
104.00	79.00	10.00	7.21	9.74	-2.53
30.00	79.00	10.00	10.14	9.74	0.40
102.00	79.00	4.00	3.35	3.90	-0.55
101.00	83.00	4.00	2.64	3.90	-1.26
10.00	77.00	3.00	5.01	2.92	2.09
90.00	82.00	3.00	4.08	2.92	1.16
8.00	78.00	2.50	1.56	2.44	-0.88
130.00	82.00	2.00	3.74	1.95	1.79
18.00	80.00	1.50	1.68	1.46	0.22
89.00	82.00	1.50	1.70	1.46	0.24
104.00	79.00	1.00	1.37	0.97	0.40
18.00	80.00	1.00	4.70	0.97	3.73
8.00	78.00	1.00	5.29	0.97	4.32
1.00	77.00	0.75	8.42	0.73	7.69
8.00	78.00	0.60	0.86	0.58	0.28
7.00	72.00	0.50	21.80	0.49	21.31
22.00	78.00	0.25	178.13	0.24	177.89

OLS -- DEPENDENT VARIABLE: mhrs_100

RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PRO
1 kit_wt	1.024959961	(0.15299)	T= 6.69960	0.0

```
SAMPLE SIZE(  1 to   13) =          13          (DF=12)
SUM OF SQUARED RESIDUALS =      347744.486885
         VARIANCE (MSE) =       28978.707240
STANDARD ERROR (ROOT MSE) =       170.231334
              R-SQUARED =          0.730284
     ADJUSTED R-SQUARED =          0.707808
F-STATISTIC(  1,   12) =         44.884593  (p=0.0000)
      SUM OF RESIDUALS =         451.301353
DURBIN-WATSON STATISTIC =          1.933468
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.648E+006	1	1.648E+006
Residual	3.477E+005	12	28978.707
Total	1.996E+006	13	1.536E+005

[EN

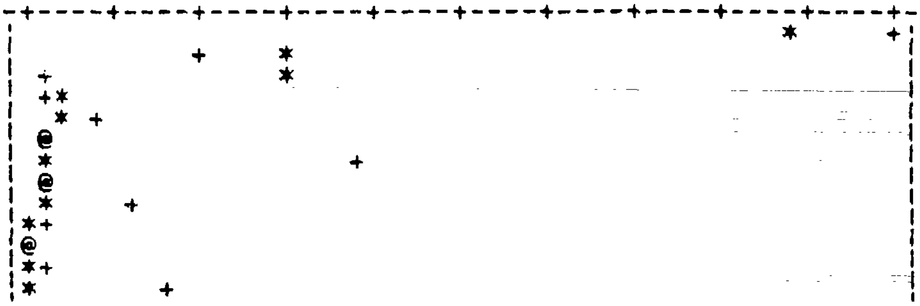
Residual Plot

```
seq.    x60    Min.=-305.37      Mean=34.72       411.47= Max.
        (*)  -+----+----+----+----+0-M-+----+----+----+----+-
  1   136.01 |                     .         *                |
  2  -130.44 |           *         .                          |
  3  -305.37 |*                    .                          |
  4   -19.20 |                    *.                          |
  5    30.27 |                     . *                        |
  6     2.22 |                     *                          |
  7   411.47 |                     .                         *|
  8    -2.76 |                     *                          |
  9   127.59 |                     .        *                 |
 10     2.46 |                     *                          |
 11    -0.11 |                     *                          |
 12    21.29 |                     . *                        |
 13   177.87 |                     .            *             |
```

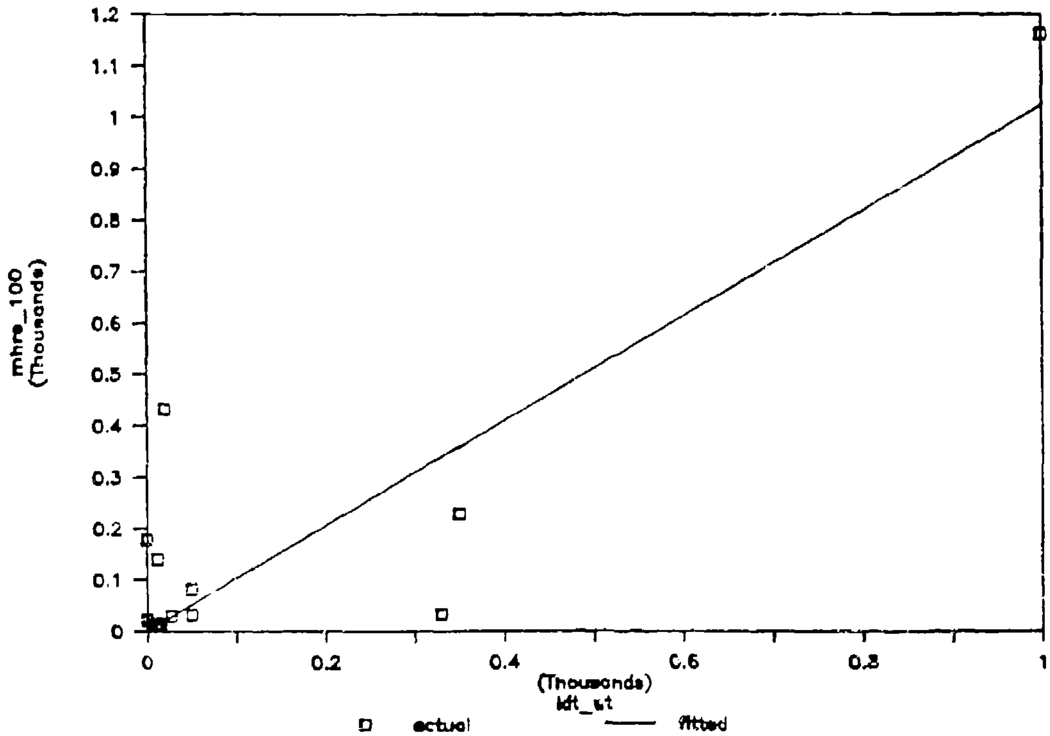
Standard Plot

seq.	FITTED (*)	mhrs_100 (+)
1	1024.96	1160.97
2	358.74	228.30
3	338.24	32.87
4	51.25	32.05
5	51.25	81.52
6	27.67	29.89
7	20.50	431.97
8	15.37	12.61
9	12.30	139.89
10	11.27	13.73
11	10.25	10.14
12	0.51	21.80
13	0.26	178.13

Min.= 0.26 1160.97= Max.



osnum	osyr	kit_wt	mhrs_100	FITTED	RESIDUAL
23.00	79.00	1000.00	1160.97	1024.96	136.01
40.00	82.00	350.00	228.30	358.74	-130.44
19.00	81.00	330.00	32.87	338.24	-305.37
23.00	79.00	50.00	32.05	51.25	-19.20
22.00	79.00	50.00	81.52	51.25	30.27
22.00	78.00	27.00	29.89	27.67	2.22
31.00	82.00	20.00	431.97	20.50	411.47
68.00	79.00	15.00	12.61	15.37	-2.76
53.00	72.00	12.00	139.89	12.30	127.59
8.00	78.00	11.00	13.73	11.27	2.46
30.00	79.00	10.00	10.14	10.25	-0.11
7.00	72.00	0.50	21.80	0.51	21.29
22.00	78.00	0.25	178.13	0.26	177.87



OLS -- DEPENDENT VARIABLE: mhrs_100

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROE
1	wir_chge	32.106898782	(16.78622)	T= 1.91269	0.06
2	kit_wt	0.826235911	(0.12382)	T= 6.67270	0.0C

SAMPLE SIZE(1 to 32) =	32	(DF=30)
SUM OF SQUARED RESIDUALS =	365405.343109	
VARIANCE (MSE) =	12180.178104	
STANDARD ERROR (ROOT MSE) =	110.363844	
R-SQUARED =	0.757211	
ADJUSTED R-SQUARED =	0.741025	
F-STATISTIC(2, 30) =	52.682293	(p=0.0000)
SUM OF RESIDUALS =	-515.999286	
DURBIN-WATSON STATISTIC =	1.716726	

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.649E+006	2	8.244E+005
Residual	3.654E+005	30	12180.178
Total	2.014E+006	32	62942.816

[ENI

Residual Plot

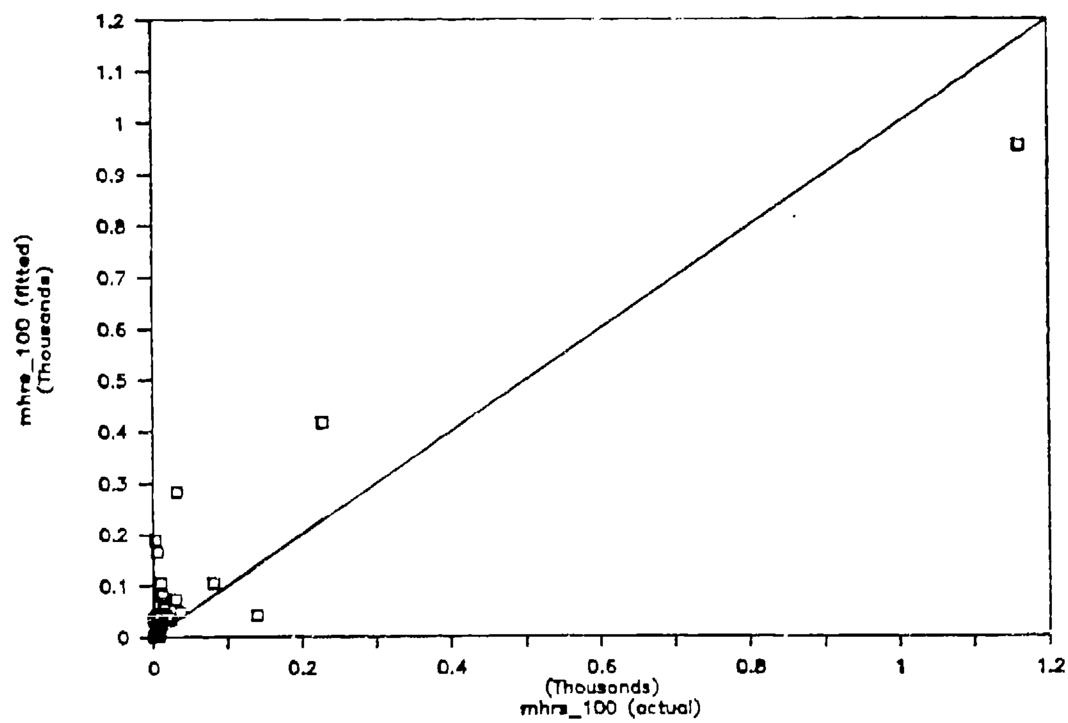
Min.=-239.79 Mean=-16.12 351.23= Max.

seq.	x59 (*)
1	206.31
2	-189.31
3	-239.79
4	-185.05
5	-159.40
6	-24.01
7	-94.44
8	351.23
9	-41.37
10	-59.57
11	113.71
12	-24.53
13	-43.90
14	97.87
15	-36.42
16	-33.16
17	-29.58
18	-32.61
19	-31.65
20	-27.64
21	-10.72
22	-9.86
23	-11.62
24	-11.59
25	-2.86
26	-0.66
27	1.60
28	0.44
29	3.87
30	0.54
31	7.80
32	0.36

Standard Plot

Min.= 0.50 1160.97= Max.

seq.	Fitted (*)	mhrs_100 (+)
1	954.66	1160.97
2	417.61	228.30
3	272.66	32.87
4	188.15	3.10
5	165.25	5.85
6	105.53	81.52
7	104.58	10.14
8	80.74	431.97
9	73.42	32.05
10	73.30	13.73
11	64.42	178.13
12	54.42	29.89
13	48.63	4.73
14	42.02	139.89
15	41.31	4.89
16	40.37	7.21
17	34.59	5.01
18	34.17	1.56
19	33.35	1.70
20	32.93	5.29
21	32.52	21.80
22	19.00	9.14
23	16.52	4.90
24	15.70	4.11
25	8.76	5.90
26	3.30	2.64
27	2.48	4.08
28	1.24	1.68
29	0.83	4.70
30	0.83	1.37
31	0.62	8.42
32	0.50	0.86



osnum	osyr	wir_chge	kit_wt	mhrs_100	Fitted	Residual
23.00	79.00	4.00	1000.00	1160.97	954.66	206.31
49.00	82.00	4.00	350.00	228.30	417.61	-189.31
19.00	81.00	0.00	330.00	32.87	272.66	-239.79
104.00	79.00	2.00	150.00	3.10	188.15	-185.05
104.00	79.00	0.00	200.00	5.85	165.25	-159.40
22.00	79.00	2.00	50.00	81.52	105.53	-24.01
30.00	79.00	3.00	10.00	10.14	104.58	-94.44
6912.00	19.00	2.00	20.00	12.00	80.74	351.23
14400.00	35.00	1.00	50.00	30.00	73.42	-41.37
3276.00	9.00	2.00	11.00	31.00	73.30	-59.57
24192.00	24.00	2.00	0.25	14.00	64.42	113.71
5184.00	23.00	1.00	27.00	14.00	54.42	-24.53
6500.00	4.00	1.00	20.00	37.00	48.63	-43.90
53.00	72.00	1.00	12.00	139.89	42.02	97.87
27.00	70.00	0.00	50.00	4.89	41.31	-36.42
864.00	9.00	1.00	10.00	18.00	40.37	-33.16
1152.00	5.00	1.00	3.00	25.00	34.59	-29.58
8.00	78.00	1.00	2.50	1.56	34.17	-32.61
89.00	82.00	1.00	1.50	1.70	33.35	-31.65
423.50	7.00	1.00	1.00	25.00	32.93	-27.64
7.00	72.00	1.00	0.50	21.80	32.52	-10.72
104.00	83.00	0.00	23.00	9.14	19.00	-9.86
8.00	78.00	0.00	20.00	4.90	16.52	-11.62
51.00	82.00	0.00	19.00	4.11	15.70	-11.59
114.00	83.00	0.00	10.60	5.90	8.76	-2.86
101.00	83.00	0.00	4.00	2.64	3.30	-0.66
90.00	82.00	0.00	3.00	4.08	2.48	1.60
18.00	80.00	0.00	1.50	1.68	1.24	0.44
18.00	80.00	0.00	1.00	4.70	0.83	3.87
104.00	79.00	0.00	1.00	1.37	0.83	0.54
1.00	77.00	0.00	0.75	8.42	0.62	7.80
8.00	78.00	0.00	0.60	0.86	0.50	0.36

```
                         OLS  -- DEPENDENT VARIABLE: mhrs_100
   RIGHT-HAND              ESTIMATED         STANDARD          T_STATISTIC       PROB
    VARIABLE              COEFFICIENT         ERROR

 1  wir_chge            40.029906736    (     28.90657)   T=      1.38480       0.19
 2    kit_wt             0.841254081    (      0.20292)   T=      4.14579       0.00

SAMPLE SIZE(   1 to    12) =           12          (DF=10)
SUM OF SQUARED RESIDUALS =     291782.352668
          VARIANCE (MSE) =      29178.235267
STANDARD ERROR (ROOT MSE) =       170.816379
               R-SQUARED =          0.755258
      ADJUSTED R-SQUARED =          0.706309
 F-STATISTIC(   2,    10) =         23.245076  (p=0.0002)
        SUM OF RESIDUALS =       -124.791386
  DURBIN-WATSON STATISTIC =          1.876184
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.648E+006	2	8.241E+005
Residual	2.918E+005	10	29178.235
Total	1.940E+006	12	1.617E+005

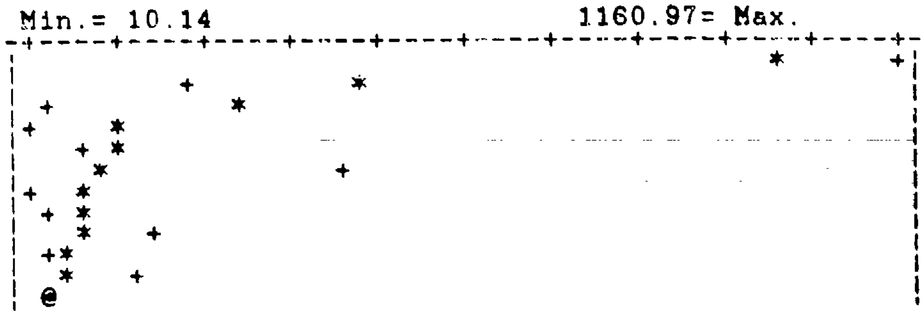
[EN]

Residual Plot

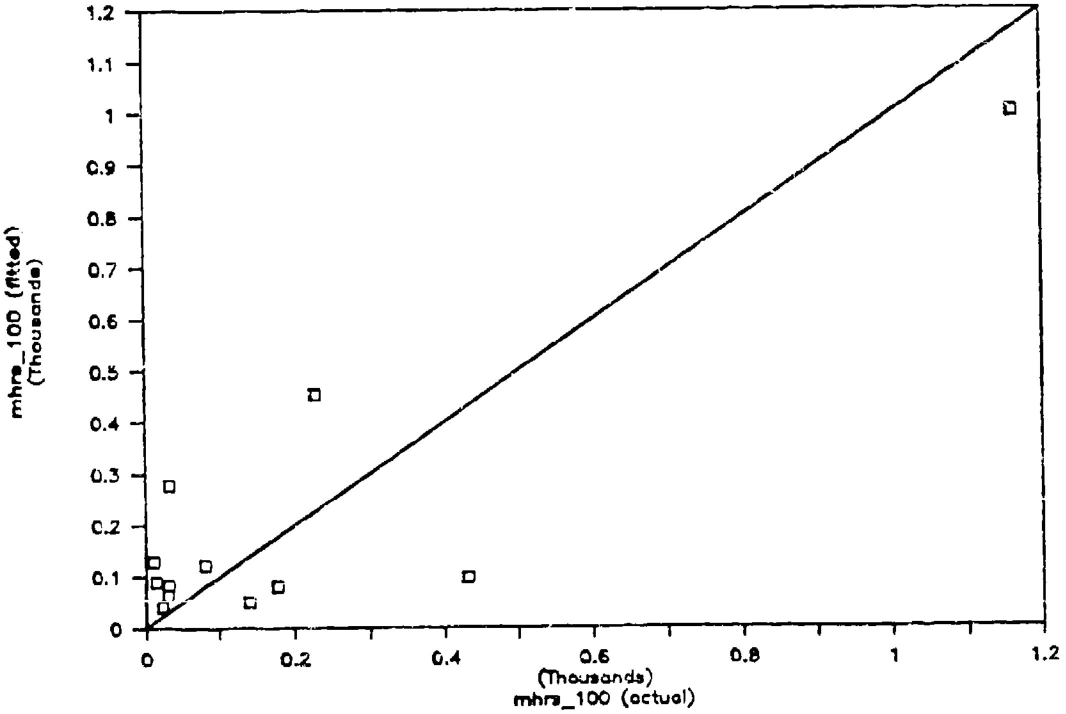
```
seq.     x58    Min.=-244.74      Mean=-10.40      335.09= Max.
         (*)  -+----+----+----+----M0---+----+----+----+----+----+-
  1   159.60  |                     .             *               |
  2  -226.26  | *                   .                             |
  3  -244.74  |*                    .                             |
  4  -118.36  |        *            .                             |
  5   -40.60  |               *     .                             |
  6   335.09  |                     .                            *|
  7   -75.58  |             *       .                             |
  8   -50.04  |              *      .                             |
  9    97.86  |                     .          *                  |
 10   -32.85  |               *     .                             |
 11    89.77  |                     .         *                   |
 12   -18.65  |                *    .                             |
```

Standard Plot

seq.	Fitted (*)	mhrs_100 (+)
1	1001.37	1160.97
2	454.56	228.30
3	277.61	32.87
4	128.50	10.14
5	122.12	81.52
6	96.88	431.97
7	89.31	13.73
8	82.09	32.05
9	80.27	178.13
10	62.74	29.39
11	50.12	139.89
12	40.45	21.80



osnum	osyr	wir_chge	kit_wt	mhrs_100	Fitted	Residual
23.00	79.00	4.00	1000.00	1160.97	1001.37	159.60
49.00	82.00	4.00	350.00	228.30	454.56	-226.26
19.00	81.00	0.00	330.00	32.87	277.61	-244.74
30.00	79.00	3.00	10.00	10.14	128.50	-118.36
22.00	79.00	2.00	50.00	81.52	122.12	-40.60
31.00	82.00	2.00	20.00	431.97	96.88	335.09
8.00	78.00	2.00	11.00	13.73	89.31	-75.58
23.00	79.00	1.00	50.00	32.05	82.09	-50.04
22.00	78.00	2.00	0.25	178.13	80.27	97.86
22.00	78.00	1.00	27.00	29.89	62.74	-32.85
53.00	72.00	1.00	12.00	139.89	50.12	89.77
7.00	72.00	1.00	0.50	21.80	40.45	-18.65



OLS -- DEPENDENT VARIABLE: mhrs_100

	RIGHT-HAND VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T_STATISTIC	PROE
1	hw_cac	2.738279536	(0.42015)	T= 6.51743	0.0C

```
SAMPLE SIZE( 35 to    48) =             14        (DF=13)
SUM OF SQUARED RESIDUALS  =      337700.873452
         VARIANCE (MSE)   =       25976.990266
STANDARD ERROR (ROOT MSE) =         161.173789
              R-SQUARED   =           0.631878
     ADJUSTED R-SQUARED   =           0.603561
 F-STATISTIC(   1,    13) =          42.476879   (p=0.0188)
        SUM OF RESIDUALS  =         -92.523594
DURBIN-WATSON STATISTIC   =           1.693556
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.441E+006	1	1.441E+006
Residual	3.377E+005	13	25976.990
Total	1.779E+006	14	1.271E+005

[ENI

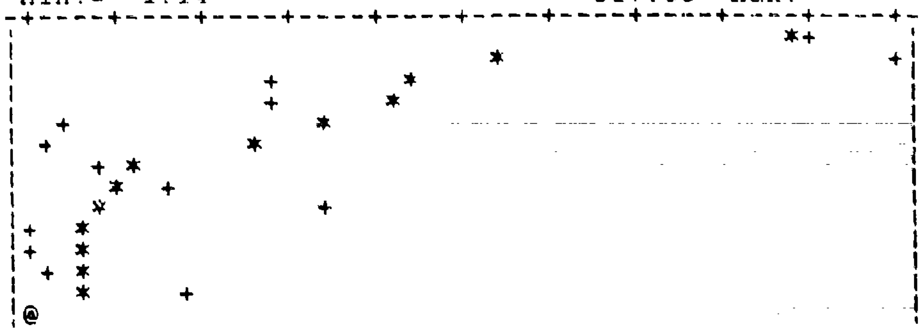
Residual Plot

```
seq. Residual  Min.=-239.30       Mean=-6.61        381.61= Max.
        (*)   -+----+----+----+--M0+----+----+----+----+----+----+-
 35     17.57  |                    . *                             |
 36    381.61  |                    .                              *|
 37   -127.19  |          *         .                               |
 38   -108.51  |            *       .                               |
 39   -239.30  |*                   .                               |
 40   -201.29  |   *                .                               |
 41    -29.28  |                 *  .                               |
 42     53.33  |                    .     *                         |
 43    211.89  |                    .                *              |
 44    -53.64  |                *   .                               |
 45    -56.36  |                *   .                               |
 46    -39.20  |                 *  .                               |
 47     99.16  |                    .        *                      |
 48     -1.31  |                    *                               |
```

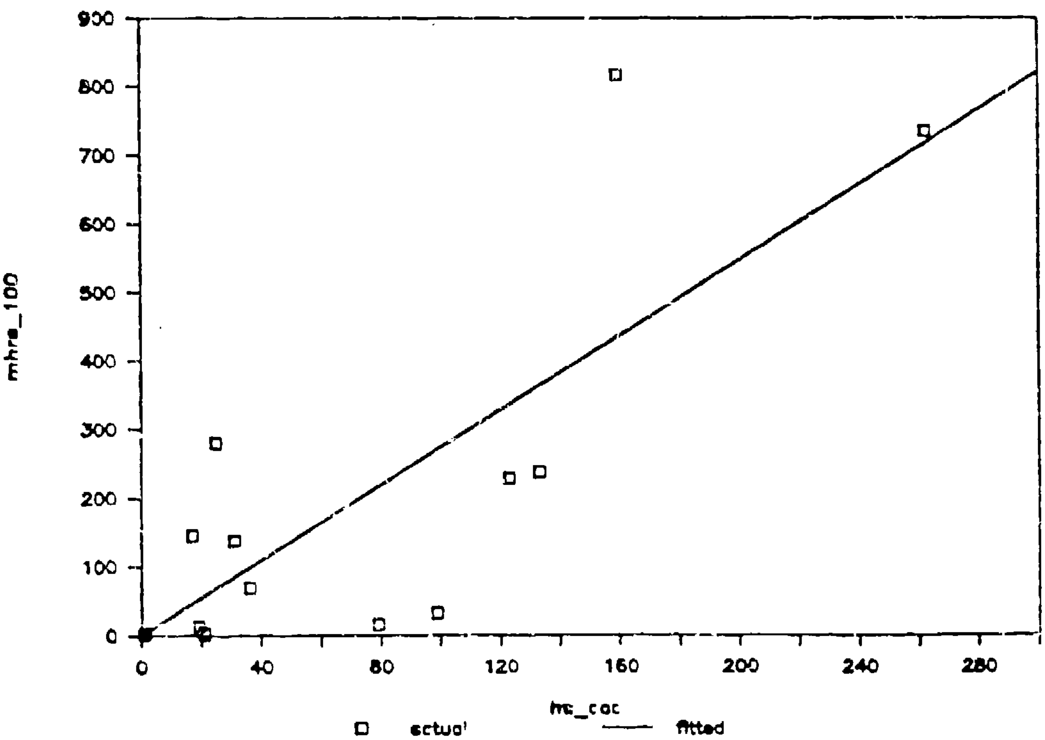
Standard Plot

Min.= 1.14 817.00= Max.

seq.	Fitted (*)	mhrs_100 (+)
35	717.43	735.00
36	435.39	817.00
37	364.19	237.00
38	336.81	228.30
39	270.51	31.21
40	216.32	15.03
41	98.58	69.30
42	84.89	138.22
43	66.46	280.35
44	57.50	3.86
45	57.50	1.14
46	52.03	12.83
47	46.55	145.71
48	3.01	1.70



osnum	osyr	hw_cac	mhrs_100	Fitted	Residual
104.00	79.00	262.00	735.00	717.43	17.57
47.00	81.00	159.00	817.00	435.39	381.61
26.00	79.00	133.00	237.00	364.19	-127.19
49.00	82.00	123.00	228.30	336.81	-108.51
15.00	80.00	98.79	31.21	270.51	-239.30
117.00	84.00	79.00	15.03	216.32	-201.29
108.00	82.00	36.00	69.30	98.58	-29.28
5.00	75.00	31.00	138.22	84.89	53.33
47.00	81.00	25.00	280.35	66.46	211.89
21.00	82.00	21.00	3.86	57.50	-53.64
6.00	83.00	21.00	1.14	57.50	-56.36
5.00	75.00	19.00	12.83	52.03	-39.20
68.00	79.00	17.00	145.71	46.55	99.16
89.00	82.00	1.10	1.70	3.01	-1.31



```
                     OLS  -- DEPENDENT VARIABLE: mhrs_100

   RIGHT-HAND          ESTIMATED          STANDARD          T_STATISTIC      PRO
    VARIABLE          COEFFICIENT          ERROR

 1    hw_cac          1.927798304    (      0.78771)    T=     2.44735      0.0
 2  unin+rem          8.084870961    (      6.54283)    T=     1.23568      0.2

 SAMPLE SIZE( 35 to    46) =            12          (DF=10)
 SUM OF SQUARED RESIDUALS =     283691.122919
           VARIANCE (MSE) =      28369.112292
STANDARD ERROR (ROOT MSE) =        168.431328
                R-SQUARED =          0.753985
       ADJUSTED R-SQUARED =          0.704782
  F-STATISTIC(   2,    10) =         19.940654  (p=0.0003)
         SUM OF RESIDUALS =       -505.777626


 DURBIN-WATSON STATISTIC =            1.432334
```

Source	SUM SQ	DF	MEAN SQ
Due to Regression	1.415E+006	2	7.075E+005
Residual	2.837E+005	10	28369.112
Total	1.699E+006	12	1.416E+005

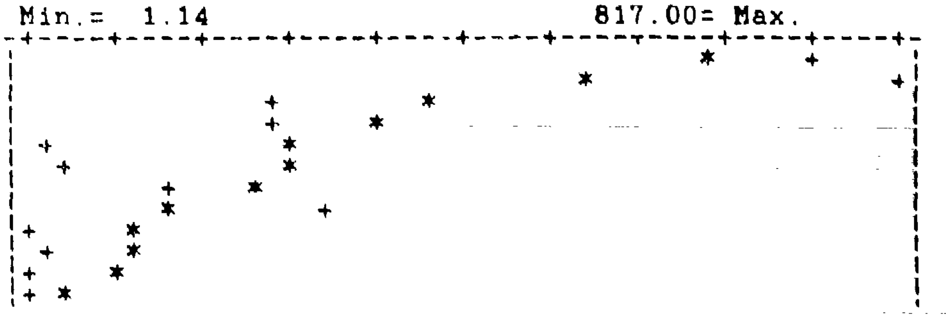
(EN

Residual Plot

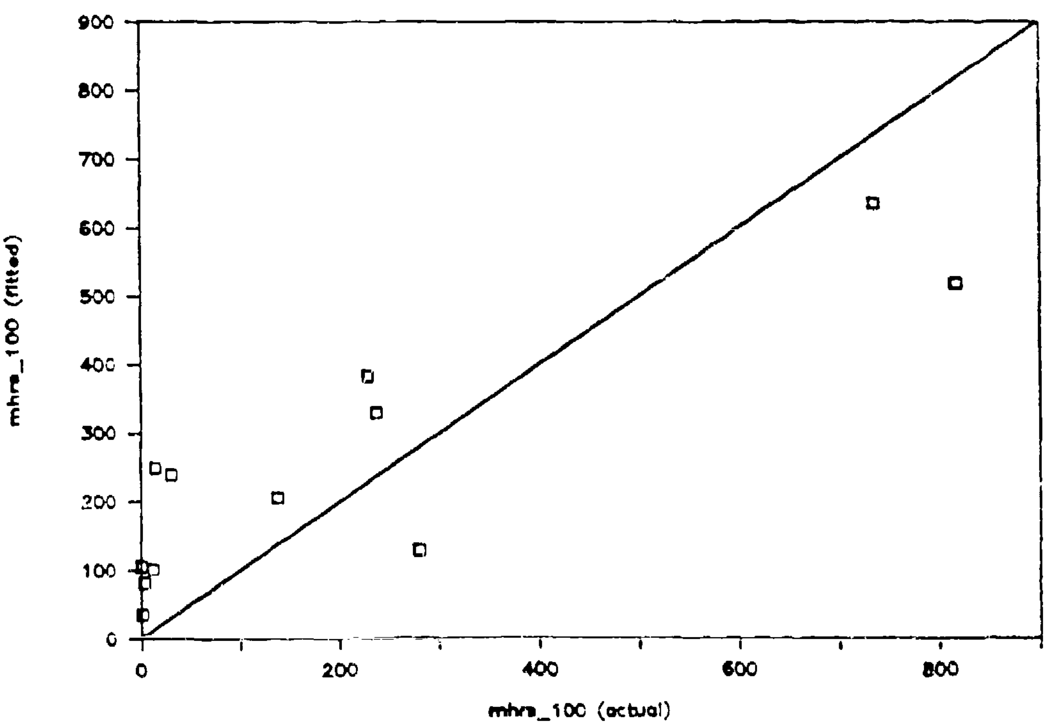
```
seq.     x58      Min.=-234.28      Mean=-42.15       300.27= Max.
         (*)    -+----+----+----+-M--+-0--+----+----+----+----+----+-
 35    100.56   |                          .         *                 |
 36    300.27   |                          .                          *|
 37   -154.35   |       *                  .                           |
 38    -92.16   |             *            .                           |
 39   -234.28   |*                         .                           |
 40   -207.75   |  *                       .                           |
 41    -67.07   |                *         .                           |
 42    151.31   |                          .              *            |
 43   -104.02   |            *             .                           |
 44    -88.48   |              *           .                           |
 45    -77.05   |               *          .                           |
 46    -32.76   |                   *      .                           |
```

Standard Plot

seq.	Fitted (*)	mhrs_100 (+)
35	634.44	735.00
36	516.73	817.00
37	382.65	228.30
38	329.16	237.00
39	249.31	15.03
40	238.96	31.21
41	205.29	138.22
42	129.04	280.35
43	105.16	1.14
44	101.31	12.83
45	80.91	3.86
46	34.46	1.70



osnum	osyr	hw_cac	unin+rem	mhrs_100	Fitted	Residual
104.00	79.00	262.00	16.00	735.00	634.44	100.56
47.00	81.00	159.00	26.00	817.00	516.73	300.27
49.00	82.00	123.00	18.00	228.30	382.65	-154.35
26.00	79.00	133.00	9.00	237.00	329.16	-92.16
117.00	84.00	79.00	12.00	15.03	249.31	-234.28
15.00	80.00	98.79	6.00	31.21	238.96	-207.75
5.00	75.00	31.00	18.00	138.22	205.29	-67.07
47.00	81.00	25.00	10.00	280.35	129.04	151.31
6.00	83.00	21.00	8.00	1.14	105.16	-104.02
5.00	75.00	19.00	8.00	12.83	101.31	-88.48
21.00	82.00	21.00	5.00	3.86	80.91	-77.05
89.00	82.00	1.10	4.00	1.70	34.46	-32.76



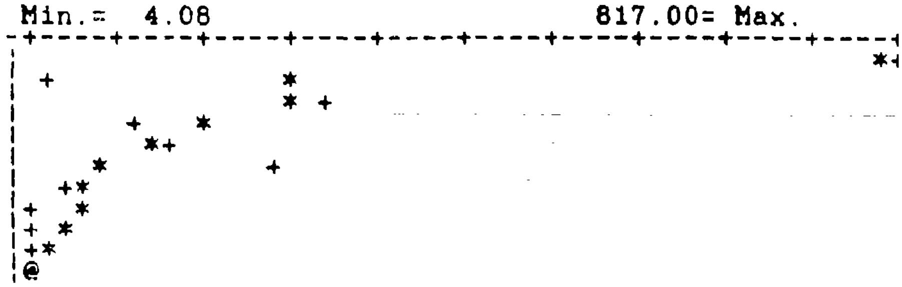
```
                    OLS  -- DEPENDENT VARIABLE: mhrs_100

  RIGHT-HAND           ESTIMATED          STANDARD         T_STATISTIC       PROI
   VARIABLE           COEFFICIENT          ERROR

 1   td_prep          1.945873730    (     0.67939)    T=     2.66416       0.0
 2    kit_wt          1.387907233    (     0.69328)    T=     2.00194       0.0

 SAMPLE SIZE(  1 to   11) =           11          (DF=9)
 SUM OF SQUARED RESIDUALS =        43897.129303
           VARIANCE (MSE) =         4877.458811
STANDARD ERROR (ROOT MSE) =           69.838806
                R-SQUARED =            0.923080
       ADJUSTED R-SQUARED =            0.905986
 F-STATISTIC(  2,     9) =           83.945371  (p=0.0000)
         SUM OF RESIDUALS =          -35.951863
  DURBIN-WATSON STATISTIC =            2.261334

                          Source |   SUM SQ      |  DF |   MEAN SQ    |
                -----------------|---------------|-----|--------------|
                Due to Regression|   8.628E+005  |    2|   4.314E+005 |
                         Residual|    43897.129  |    9|     4877.459 |
                            Total|   9.067E+005  |   11|    82424.949 |
                -----------------|---------------|-----|--------------|  [EN
```

```
                               Residual Plot
seq.     x59    Min.=-76.32      Mean=-3.27       164.80= Max.
          (*)  -+----+----+----M0---+----+----+----+----+----+----+-
 1      15.86  |                .   *                                |
 2     -76.32  |*               .                                    |
 3      38.35  |                .        *                           |
 4     -68.35  | *              .                                    |
 5      19.34  |                .    *                               |
 6     164.80  |                .                                   *|
 7     -26.66  |         *      .                                    |
 8     -39.32  |       *        .                                    |
 9     -38.99  |       *        .                                    |
10     -17.96  |           *    .                                    |
11      -6.70  |             *  .                                    |
```

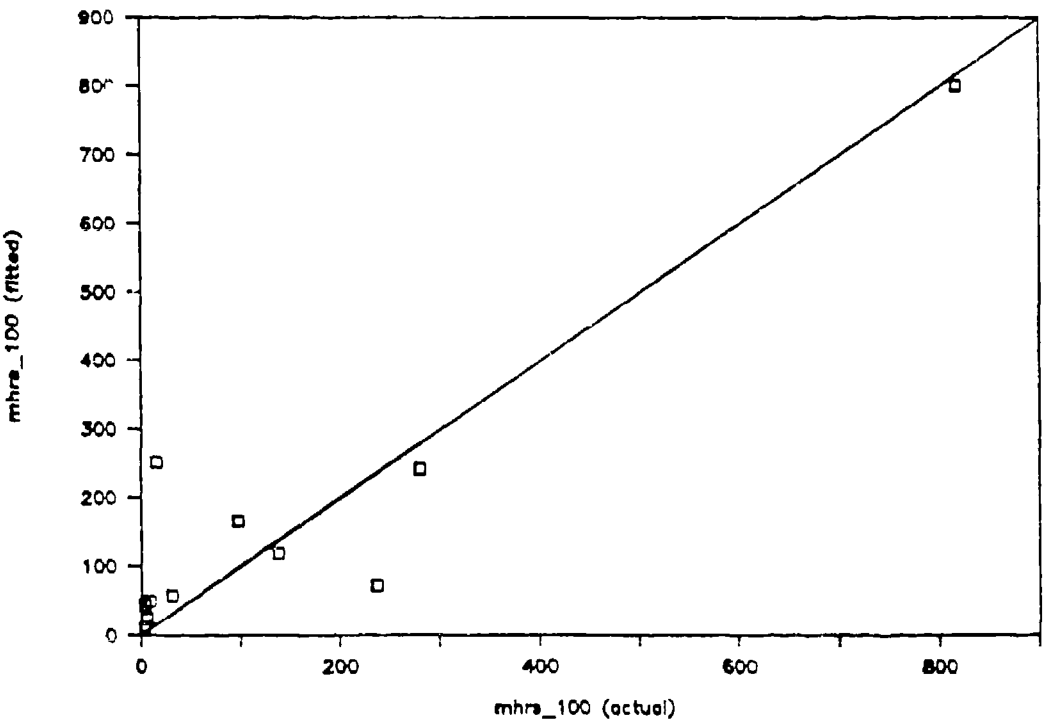
Standard Plot

seq.	Fitted (*)	mhrs_100 (+)
1	801.14	817.00
2	251.78	16.00
3	242.00	280.35
4	165.85	97.50
5	118.88	138.22
6	72.20	237.00
7	57.87	31.21
8	48.46	9.14
9	43.10	4.11
10	23.86	5.90
11	10.78	4.08

Min.= 4.08 817.00= Max.



osnum	osyr	td_prep	kit_wt	mhrs_100	Fitted	Residual
47.00	81.00	233.40	250.00	817.00	801.14	15.86
95.00	23.00	75.90	75.00	16.00	251.78	-76.32
47.00	81.00	110.10	20.00	280.35	242.00	38.35
60.00	82.00	46.00	55.00	97.50	165.85	-68.35
5.00	75.00	45.40	22.00	138.22	118.88	19.34
26.00	79.00	10.00	38.00	237.00	72.20	164.80
15.00	80.00	27.60	3.00	31.21	57.87	-26.66
104.00	83.00	8.50	23.00	9.14	48.46	-39.32
51.00	82.00	8.60	19.00	4.11	43.10	-38.99
114.00	83.00	4.70	10.60	5.90	23.86	-17.96
90.00	82.00	3.40	3.00	4.08	10.78	-6.70



APPENDIX B

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

KEY TO APPENDIX B

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

The data elements included in the data base are defined as follows. (The definitions are listed in order of appearance in the data base. The OSIP and TD numbers appear at the left margin of each page, for easy reference.)

OSIP# - Operational Safety Improvement Program Number, as shown in the Congressional Budget Submission backup data.

TD# - Technical Directive number(s) to which the other information in the data base pertains.

Basic Mission - Basic mission of the aircraft, as indicated by the third symbol of the aircraft designation.

Modified Mission - Modified mission of the aircraft, as indicated by the second symbol of the aircraft designation.

Mod Category - Aircraft category under which the related OSIP appeared in the Congressional Budget Submission backup data.

CCB# - Number of CCB from which data was derived, if applicable.

ECP# - Related ECP, obtained from the CCB.

TD Title - Title of the Technical Directive.

Description - Description of the change.

Installer:

NARF - Naval Air Rework Facility
- CTA - Component Turn-around
- SDLM - Standard Depot Level Maintenance
- DI - Drive-in
- FMT - Field Maintenance Team
- N/S - not specified

Contractor
- CTA - Component Turn-around
- SDLM - Standard Depot Level Maintenance
- DI - Drive-in
- FMT - Field Maintenance Team
- N/S - not specified

O&I - Organizational and Intermediate level

Also in Production - Change affects aircraft in production.

Aircraft Type:

F/A - Fighter/Attack
AEW - Airborne Early Warning
ASW - Anti-Submarine Warfare
HELO - Helicopter
CARGO - Cargo

Installation Type:

NAV - Navigational Equipment
ID - Identification Equipment
ECM - Electronic Counter-Measures
ESM - Electronic Support Measures
RADAR - Radar
E-O - Electro-Optical
MISSILE - Missile
ARM - Armament
SURV - Survival
F/C - Fire Control
MISC - Miscellaneous

Wing Station or Pod Mount - Change is on wing station or pod.

Aircraft - Specific aircraft models affected.

OSIP Srce. (FY) - FY Congressional Budget Submission where OSIP costs obtained.

Non-Recurring - Total non-recurring cost, in FY84 $K.

Eng Dev/Design/Test - Engineering development, design and test non-recurring costs, in FY84 $K.

Tooling - Tooling non-recurring costs, in FY84 $K.

NRE - Non-recurring engineering costs, in FY84 $K.

Tech. Dir. Prep. - Technical Directive preparation non-recurring costs, in FY84 $K.

Tech. Dir. P&P - Technical Directive printing and distribution non-recurring costs, in FY84 $K.

Drawings - Drawings non-recurring costs, in FY84 $K.

Test - Test non-recurring costs, in FY84 $K.

Data/Pubs - Data and publications costs, in FY84 $K.

Publications - Publications non-recurring costs, in FY84 $K.

Pubs Printing - Publications printing and distribution non-recurring costs, in FY84 $K.

ILS - Integrated Logistics Support non-recurring costs, in FY84 $K.

Kit-CAC or Ave. - Modification kit cumulative average cost at unit 100 (or average, if calculated learning curve unacceptable), in FY84 $K.

Kits Total - Total cost of modification kits, in FY84 $K.

H/W Total - Total cost of hardware installed, in FY84 $K.

H/W Incl. in Kits ? (Y/N) - Whether the hardware is included in the installation kit (if this occurred, the kit cost was negligible compared to the hardware, and was included under the hardware cost element).

Rep't Install Mhrs - Average installation manhours to date (from TDSA).

Rep't Install Mhrs @ 100 - Estimated manhours to install change number 100 (derived from TDSA data).

Est'd Install Mhrs - Estimated manhours to perform installation (from TD).

%Struct - Percent of estimated manhours to install performed by structural labor.

%Mech - Percent of estimated manhours to install performed by mechanical labor.

%Electr - Percent of estimated manhours to install performed by electrician labor.

Trainer Install Mhrs @ 100 - Estimated manhours to install change number 100 (derived from TDSA data).

Spares Install Mhrs @ 100 - Estimated manhours to install change number 100 (derived from TDSA data).

Install CAC or Ave. - Cumulative average cost at unit 100 (or average if calculated learning curve was unacceptable) of installation, in FY84 $K.

Refurbish Update - Cost of refurbishment or update required by change, in FY84 $K.

PSE - Peculiar Support Equipment, in FY84 $K.

PSE Engr. - Peculiar Support Equipment engineering, in FY84 $K.

Oper. Flt. Trainer Kit Ave. - Operational Flight Trainer Kit average cost, in FY84 $K.

NAMT Trainer Kit Ave - Naval air maintenance trainer kit average cost, in FY84 $K.

Trainer Eng. - Trainer engineering cost, in FY84 $K.

Trainer Mod Kits - Trainer modification total kit cost, in FY84 $K.

Trainer H/W - Trainer hardware cost, in FY84 $K.

Spares - Spares cost, in FY84 $K.

Installation - Total installation cost, in FY84 $K.

Unit Wt. - Unit weight of aircraft.

Empty Wt. - Empty weight of aircraft.

Avionics Equip. Wt. - Weight of avionics equipment installed in aircraft.

Avionics Install Wt. - Weight of avionics installation equipment in aircraft.

Electrical Grp. Wt. - Weight of electrical equipment in aircraft.

Lau/Rack/Pylon Wt. - Weight of launchers, racks, and pylons in aircraft.

Fuselage Volume - Volume (cubic feet) of aircraft fuselage.

No. Airframe TDs - No. airframe TDs related to change.

No. Avionics TDs - No. avionics TDs related to change.

No. Armament TDs - No. armament TDs related to change.

No. Supt. Eq. TDs - No. support equipment TDs related to change.

No. Other TDs - No. other TDs related to change.

No. Basic A Kits - No. separate basic kits required.

No. Spares B Kits - No. separate spares kits required.

No. Trainer E/K Kits - No. separate trainer kits required.

No. Other Kits - No. other separate kits required.

No. Boxes Installed - No. separate "black-box" systems installed.

No. Boxes Removed - No. separate "black-box" systems removed.

No. Boxes Mod'ed - No. separate "black-box" systems modified.

No. Units Installed - No. components installed.

No. Units Removed - No. components removed.

No. Units Modified - No. components modified.

Wt. Total Installed - Total weight installed.

Wt. Units Installed - Weight of components installed.

Wt. Units Removed - Weight of components removed.

Wt. Hardware Install. - Weight of miscellaneous hardware (brackets, shelves, etc.) installed.

Wt. Hardware Removed - Weight of miscellaneous hardware (brackets, shelves, etc.) removed.

Wt. Cables Installed - Weight of cabling installed.

Wt. Cables Removed - Weight of cabling removed.

Total Wt. Change - Net weight change to aircraft as result of modification (may be positive or negative).

Wiring Change - Complexity of wiring change resulting from modification (see Appendix C for details): 0 = none, 1 = small, 2 = medium, 3 = large, 4 = major rewire of aircraft.

Interf. - Y if CCB noted that the change involved an interface requirement (another change is required in order to implement the current change).

FFF? - Y if OSIP or CCB noted that is a form-fit-function change.

Basic Kit Wt. - Shipping weight of the basic kit (from TD), in pounds.

Basic Kit Dim's - Shipping dimensions of the basic kit (in cubic inches).

No. Documents Affected - Document (drawings, etc.) affected by the change (from the TD).

Trainer Kit Wt. - Shipping weight of trainer kit, in pounds.

Trainer Kit Dim's - Shipping dimensions of trainer kit, in cubic inches.

Est'd Install Mhrs - Estimated manhours to install trainer kit.

Spares Kit Wt. - Shipping weight of spares kit, in pounds (from TD).

Spares Kit Dim's - Shipping dimensions of spares kit, in cubic inches (from TD).

Est'd Install Mhrs - Estimated manhours to install spares kit.

GFE Kit Wt. - Shipping weight of GFE kit (includes "black-box" equipment), in pounds.

GFE Kit Dim's - Shipping dimensions of GFE kit (includes "black-box" equipment), in cubic inches.

Rep't Install Mhrs - Reported manhours to install GFE kit.

Est'd Install Mhrs - Estimated manhours to install GFE kit.

EQ Type - Equipment type (derived from "AN/-" designation.

EQ Purpose - Equipment purpose (derived from "AN/-" designation.

Footnotes - Footnote numbers relevant to change.

CCB Description Paragraph # - Description of specific CCB action, if appropriate.

The data based used to develop the CERs is presented in pages B-8 through B-37. Each set of opposing pages (e.g. B-8 and B-9) shows several of the variables for the 87 data points in the data base. Each progressive set of pages shows different variables contained in the data base "matrix". The OSIP number and TD number always appear at the left-hand margin on each page. The order in which the variables appear, and the variable definitions, were provided on pages B-1 through B-6. Pages B-38 through B-44 provide the footnotes to the data base, and pages B-45 through B-49 provide the descriptions of the CCB actions.

OSIP #	TD#	BASIC MISSION	MOD'ED MISSION	MOD CATEGORY	CCB#	ECP#
27-70	VCM 50 0210	Cargo	Electronic	C-130		
7-72	AAE 50 0461	Attack	(Var)	A-4		
7-72	AAC 50 0555	Attack	(Var)	A-4		
7-72	AFP 50 0570	Attack	(Var)	F-4		
53-72	APB 50 0401	Patrol		P-3		
53-72	APB 50 0410	Patrol		P-3		
53-72	AFB 50 0233	Patrol		P-3		
53-72	APB 50 0404	Patrol		P-3		
53-72	APB 50 0326	Patrol		P-3		
31-73	YCA 54 2345	Attack		A-6		
31-73	YCA 54 2496	Attack		A-6		
48-74	AAF 50 0405	Attack		A-7		
48-74	AAF 50 0409	Attack		A-7		
5-75	AAF 50 0350	Attack		A-7	761-191	24-74 P.I
5-75	AAF 50 0382	Attack		A-7	751-506	ECP-VO A7-485
28-75	ACM 50 0246	Cargo	Electronic	C-130		
1-76	AAR 50 0493	Attack		A-6		
1-77	YCA 54 2233	Attack		A-4		
1-77	YCA 54 2232	Attack		A-4		
1-77	AAC 50 0567	Attack		A-4		
10-77	AAE 50 0482	Attack	Electronic	A-6		
10-77	AAE 50 0454	Attack	Electronic	A-6		
8-78	AHB 50 0281	Helo	Antisub	H-2		
8-78	YCA 54 2628	Helo	Antisub	H-2		
8-78	AHB 50 0267	Helo	Antisub	H-2		
8-78	AHB 50 0267	Helo	Antisub	H-2		
8-78	AHB 50 0283	Helo	Antisub	H-2		
8-78	AHB 50 0269	Helo	Antisub	H-2		
8-78	AHB 54 2533	Helo	Antisub	H-2		
8-78	AHB 50 0274	Helo	Antisub	H-2		
22-78	APB 50 0350	Patrol		P-3		
22-78	APB 50 0395	Patrol		P-3		
21-79	AAF 50 0483	Attack	Electronic	EA-6	791-340	GP-EA6B-30R1
22-79	YCA 54 2537	Attack	Electronic	A-6		
22-79	AAE 50 0472	Attack	Electronic	A-6		
23-79	AAF 50 0412	Attack	Electronic	A-7		
23-79	AAF 50 0398	Attack	Electronic	A-7		
23-79	AAF 50 0401	Attack	Electronic	A-7		
23-79	AAF 50 0390	Attack	Electronic	A-7		
23-79	AAF 50 0389	Attack	Electronic	A-7		
25-79	AAF 50 0387	Attack		A-7		
26-79	AAF 50 0411	Attack		A-7	791-241	VOught 572
30-79	YCA 54 2277	Fighter		F-4		
63-79	AYH 50 0082	Observation	(VSTOL)	OV-10	871-236	OV-10-30
66-79	AHR 50 0339	Helo	Cargo	H-46		
68-79	AHX 50 0277	Cargo	(Helo)	H-53	811-69	ECP-1R3
68-79	AHX 50 0277	Cargo	(Helo)	H-53	811-69	ECP-1R2

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	BASIC MISSION	MOD'ED MISSION	MOD CATEGORY	CCB#	ECP#
102-79	YCA 54 2479	Antisub		S-3		
104-79	YCA 54 2693	Patrol		P-3		
104-79	YCA 66 0749	Patrol		P-3		
104-79	APB 50 0405	Patrol		P-3	811-139	P-3-947
104-79	APB 50 0406	Patrol		P-3		
104-79	APB 50 0402	Patrol		P-3		
104-79	APB 50 0388	Patrol		P-3	791-259	933S1
13-80	AAF 50 0421	Attack		A-7		
15-80	YCA 54 2427	Attack		A-7	781-330	ECP 559R1
15-80	QAF 50 0410	Attack		A-7	781-330	ECP 559R1
18-80	YCA 54 2548	Attack		A-7		
18-80	YCA 54 2751	Attack		A-7		
19-81	YCA 54 2523	Fighter		F-4		
47-81	YCA 54 2562/3	Patrol		P-3	811-264	949 Option 1
47-81	APB 50 0408	Patrol		P-3	811-201	925R1 Option I
47-81	APB 50 0414	Patrol		P-3	811-264	949 Option 1
100-81	AAB 50 0500	Attack	Electronics	A-3		
100-81	AAB 50 0501	Attack	Electronics	A-3		
21-82	AHR 50 0345	Cargo	(Helo)	H-46	821-55	ECP H-46-27
31-82	APB 50 0427	Patrol		P-3		
49-82	AEB 50 0303	Electronic		E-2	801-145	ECP-CP-E2C 292
51-82	YCA 54 2588	Attack		A-6	812-60	ECP 1K0052R3
60-82	AFP 50 0660	Attack		F-4	821-250	ECP 571
62-82	AFW 50 0670	Fighter		F-14	821-44	829
62-82	YCA 54 2564/65/66	Fighter		F-14	822-19	PMS 259N-1
62-82	AFW 50 0668	Fighter		F-14	791-280	995
62-82	VFU 50 0671	Fighter		F-14		
71-82	APB 50 0424	Patrol		P-3		
78-82	YCA 54 2597	Common		Common	822-90	001
89-82	AAE 50 0551	Attack		Common	841-42/821-313	ECP 122/NARF JA
90-82	YCA 54 2596	Common		Common	822-78	573
108-82	ATJ 50 0628	Trainer	Cargo	T-39	821-176	ECP-001
130-82	AAC 50 0636	Attack	Trainer	A-4		
6-83	AAC 50 0602	Attack		A-4	781-162	A4-PN114
101-83	AHB 50 0296	Helo	(Var)	H-2		
101-83	YCA 54 2692	Helo	(Var)	H-2		
104-83	QAE 54 2691	Common		Common	832-88	507
114-83	AHB 50 0297	Common		Common	841-266	ECP H2-PN23
114-83	YCA 54 2658	Common		Common	832-37	ECP 577C1
117-84	ACH 50 0291	Cargo	(Var)	C/KC-130	841-373	C-130-48

OSIP #	TD#	TD TITLE
27-70	VCM 50 0210	E1 B Node 1 Capacitor Bank Insul Strip Arc Pvnt
7-72	AAE 50 0461	Install provisions for AN/APS-117 Strike TIAS
7-72	AAC 50 0555	Retrofit AN/APN-194 Radar Altimeter System, replacing AN/APN-141 Radar
7-72	AFP 50 0570	AN/ALQ-162 Antenna Fastening to Support Antenna Testing Devices
53-72	APB 50 0401	P-3 Weapon Delivery A/A47U-1 Marine Marker Pneumatic Retro Ejec. Removal
53-72	APB 50 0410	Update Existing DIFAR System to AN/AQA-74(V)9, Incorp. DICASS Capability
53-72	AFB 50 0233	Preclude Entry of Foreign Objects into Wing Tank Fuel Pump
53-72	APB 50 0404	RD-461/A Magnetic Tape Recorder & MILSTD 1553B Data Bus Provisions
53-72	APB 50 0326	Install New Tactical Naval System AN/ASN-124 and Updated DIFAR System into P-3B
31-73	YCA 54 2345	Reduced Lighting for Weapon Control System AWG-21
31-73	YCA 54 2498	Weapon Control System AN/AWG-21; Moisture Proofing Launch Indicator
48-74	AAF 50 0405	Provide for Removal of the AN/APN-52V TACAN & Installation of AN/ARN-84(V)
48-74	AAF 50 0409	Provide Instruction for Remov. of AN/ARN-52 TACAN Sys. & Inst. AN/ARN-118
5-75	AAF 50 0350	Model A-7A/B AN/ARC-159(V) UHF Radio
5-75	AAF 50 0382	A-7E Replacement of ARC-51/ARR-69 with two ARC-159 Radios
28-75	ACM 50 0246	Transient Suppresion of UH F-1 and UHF-2 Keying Relays
1-78	AAE 50 0493	Instructions for the Installation of the Radar Warning Receiver
1-77	YCA 54 2233	Modification of C-6682/AWE-1 Controller to Convert to TD-1317/AWE
1-77	YCA 54 2232	Modification of Relative Wind Transducer
1-77	AAC 50 0567	Install Angle Rate Bombing System
10-77	AAE 50 0482	Instructions for Reloc. of C-9054/ARN-84 & C-4418A/APN-153 Control Panels
10-77	AAE 50 0454	Avionics, Basic Aircraft Rewire and Update
8-78	AHB 50 0281	DIFAR/DICASS Sonobuoy Data Link, Installation
8-78	YCA 54 2628	ASQ81 Detector Head Reliability Improvement. Retrofit of MAD Towed Body
8-78	AHB 50 0267	AN/ASN-123 Tacan System
8-78	AHB 50 0267	Correction of Defect: Return Capability of Sensor Operator
8-78	AHB 50 0283	Mod. to Provide ESM Volume Control, ALR-66(V)1
8-78	AHB 50 0269	LN66HP Radar Range Improvement, Improve Signal for Noise Ratio
8-78	AHB 54 2533	AN/AKT-22 DIFAR/DICASS SONOBUOY Link
8-78	AHB 50 0274	AN/ARC-159-1, UHF Transceiver
22-78	APB 50 0350	Communication Capability Between Air and Surface Units
22-78	APB 50 0395	Coded Communications Between P-3 and Submarines
21-79	AAF 50 0483	ALE-41 Chaff Dispenser Installation EA-6B
22-79	YCA 54 2537	Countermeasures Dispensing System, AN/ALE-39 Suppr. of Noise Transients
22-79	AAE 50 0472	Incorporation of Dispensing Set
23-79	AAF 50 0412	Restore Automatic Anti-Ice Feature to Pilot-Controlled Capability
23-79	AAF 50 0396	FLIR Aircraft Altitude Hold Disengage Warning System
23-79	AAF 50 0401	Radar Altimeter Warning Light
23-79	AAF 50 0390	AN/AVQ-7 HUD Inclusion of FLIR Capability
23-79	AAF 50 0389	Increase of A/C Operat. Capab. by Adding Muli-Munitions & FLIR Provisions
25-79	AAF 50 0387	Replace Existing AN/ALE-29A Chaff with AN/ALE-39
26-79	AAF 50 0411	Electronic Warfare Improvements
30-79	YCA 54 2277	AN/AWG-10 Digital Auto Acquisition
63-79	AYH 50 0082	AN/ALE-39; Provisions for
66-79	AHR 50 0339	Installation of AN/ALE-39, AN/APR-39, Removal of AN/ALE-39
68-79	AHX 50 0277	Retrofit of AN/ALE-30 and AN/APR-39 in CH-53A/D Aircraft
68-79	AHX 50 0277	Retrofit of AN/ALE-30 and AN/APR-39 in CH-53A/D Aircraft

OSIP #	TD#	TD TITLE
102-79	YCA 54 2479	Modification of C-8759/AA or C-8759A/AA Infrared Control Converter
104-79	YCA 54 2693	Harpoon Interconnecting Box J-3390/AWG-19(V)
104-79	YCA 56 0749	Standardization of Armament; Wing Pylon
104-79	APB 50 0405	Harpoon Missile Capability, Update
104-79	APB 50 0406	Standardized Wing Pylons Retrofit
104-79	APB 50 0402	Install Harpoon Inflight Missile Simulator (HMS)
104-79	APB 50 0388	Harpoon Missile Sys. Inst. of Pilot's Arm. Ctrl Panel Mod, Tactical Coordinator Control Pa
13-80	AAF 50 0421	Provisions for HARM Missile Incorporation into A7E
15-80	YCA 54 2427	Mod. of AN/APQ-126(V) FLIR: AS-2272, C-8251, PP-6130
15-80	QAF 50 0410	Improved Digital Scan Converter Group: A-7E Installation
18-80	YCA 54 2548	Modification of Guided Weapon Control-Monitor Set AWW-7B
18-80	YCA 54 2751	Modification of Walleye Frequency Control to Expand Frequency Capability
19-81	YCA 54 2523	AN/AWG-10A Technical Obsolescence Program
47-81	YCA 54 2562/3	Mod. of A366/A373 Nav. Intercon. Box to Provide Add'l Outputs to OMEGA Nav. Sys.
47-81	APB 50 0408	LTN-72 INS in lieu of ASN-84 Retrofit
47-81	APB 50 0414	LTN-211 OMEGA in lieu of ARN-81 LORAN Retrofit
100-81	AAB 50 0500	Installation of AN/APS-133 Color Weather Radar System.
100-81	AAB 50 0501	Installation of AN/ARC-175, ARN-126, and AN/ARC-120
21-82	AHR 50 0345	Replace existing TACAN, AN/ARN-57 with newer more reliable TACAN, AN/ARN-118
31-82	APB 50 0427	AN/ASA-65 (V)2 Magnetic Compensator Group Adapter
49-82	AEB 50 0303	Incoporation of PDS Level I Improvements
51-82	YCA 54 2588	Search, Terrain CLearance and AFC Modules for APQ-156 Radar
60-82	AFP 50 0660	AN/ARN-159 Radio Sets
62-82	AFW 50 0670	Installation of Television Camera Set (TCS) System and Airborne Video Tape Recorder (AVTR)
62-82	YCA 54 2564/65/66	AN/AXX-1 Television Camera Sight Interface
62-82	AFW 50 0668	Installation of Cockpit Television Sensor
62-82	VFU 50 0671	Replace Existing IR System with TV Camera Sensor System
71-82	APB 50 0424	Installation of KY-75 Tactical Speech Security Equipment
78-82	YCA 54 2597	SLZ-9028G angle of attack reliability improvement
89-82	AAE 50 0551	Replacement of AS-1233 APN-141 Antenna
90-82	YCA 54 2596	RT-868A/APX-76 & RT-988/A Improvement Plan
108-82	ATJ 50 0628	Inst. of PRIMUS 400 Radar System
130-82	AAC 50 0638	Instructions for Retrofit of Mod. CPU-66/A Alt. Encoding Computer
6-83	AAC 50 0602	AN/ARN-118 V TACAN, Installation of
101-83	AHB 50 0296	Installation of Modified AN/APN-171(V) Radar Altimeter System
101-83	YCA 54 2692	Mod. of Rec.-Transmitters to Rep. Tube Cav. Oscillator w/ S.S. Receiver
104-83	QAE 54 2691	ARC-51A Receiver/Transmitter Mod.
114-83	AHB 50 0297	Modification of APN-182(V) Radar Navigation Set
114-83	YCA 54 2658	AN/APN-182 Reliability & Maintainability Improvement
117-84	ACM 50 0291	Avionics Systems Improvement Program (ASIP) Phase II

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

			INSTALLER									
			NARF					CONTR				
OSIP #	TD#	DESCRIPTION	CTA	SDLM	DI	FMT	N/S	CTA	SDLM	DI	FMT	N/S
27-70	VCM 50 0210											
7-72	AAE 50 0461						1					
7-72	AAC 50 0555						1					
7-72	AFP 50 0570											
53-72	APB 50 0401						1					
53-72	APB 50 0410						1					
53-72	AFB 50 0233						1					
53-72	APB 50 0404						1					
53-72	APB 50 0326						1					
31-73	YCA 54 2345											1
31-73	YCA 54 2496											1
48-74	AAF 50 0405											
48-74	AAF 50 0409						1					
5-75	AAF 50 0350			1		1						
5-75	AAF 50 0382			1		1						
28-75	ACM 50 0246											1
1-76	AAE 50 0493											
1-77	YCA 54 2233						1					
1-77	YCA 54 2232						1					
1-77	AAC 50 0567						1					
10-77	AAE 50 0482											
10-77	AAE 50 0454						1					
8-78	AHB 50 0281						1					
8-78	YCA 54 2628						1					
8-78	AHB 50 0267						1					
8-78	AHB 50 0267											
8-78	AHB 50 0283											
8-78	AHB 50 0269											
8-78	AHB 54 2533						1					
8-78	AHB 50 0274											
22-78	APB 50 0350						1					
22-78	APB 50 0395										1	
21-79	AAF 50 0483			1								
22-79	YCA 54 2537						1					
22-79	AAE 50 0472						1					
23-79	AAF 50 0412										1	
23-79	AAF 50 0398										1	
23-79	AAF 50 0401										1	
23-79	AAF 50 0390											1
23-79	AAF 50 0389											1
25-79	AAF 50 0387						1					
28-79	AAF 50 0411			1		1					1	
30-79	YCA 54 2277						1					
63-79	AYH 50 0082										1	
66-79	AHR 50 0339						1					
68-79	AHX 50 0277	Removal & Rework of AN/ALE-29									1	
68-79	AHX 50 0277	Install of AN/ALE-39 & AN/APR-39									1	

OSIP #	TD#	DESCRIPTION	INSTALLER NARF CTA	NARF SDLM	NARF DI	NARF FMT	NARF N/S	CONTR CTA	CONTR SDLM	CONTR DI	CONTR FMT	CONTR N/S
102-79	YCA 54 2479											
104-79	YCA 54 2693											
104-79	YCA 56 0749											1
104-79	APB 50 0405	HACLS installation to P-3C									1	
104-79	APB 50 0406											
104-79	APB 50 0402											
104-79	APB 50 0388	HACLS installation to P-3B									1	
13-80	AAF 50 0421						1					
15-80	YCA 54 2427	Modification of FLIR Components									1	
15-80	QAF 50 0410	Removal/Installation of DSCG									1	
18-80	YCA 54 2548											
18-80	YCA 54 2751											
19-81	YCA 54 2523						1					
47-81	YCA 54 2562/3	Mod. of LTN-211 components									1	
47-81	APB 50 0408	Installation of LTN-72									1	
47-81	APB 50 0414	Installation of LTN-211									1	
100-81	AAB 50 0500						1					
100-81	AAB 50 0501					1						
21-82	AHR 50 0345			1								
31-82	APB 50 0427										1	
49-82	AEB 50 0303										1	
51-82	YCA 54 2588											
60-82	AFP 50 0660			1		1					1	
62-82	AFW 50 0670										1	
62-82	YCA 54 2564/65/66	Modifies AN/AWG-9 to be compatible with TCS.						1				
62-82	AFW 50 0668	electrical provisions to install KB-26B Gun Camera.									1	
62-82	VFU 50 0671						1					
71-82	APB 50 0424											
78-82	YCA 54 2597							1				
89-82	AAE 50 0551											
90-82	YCA 54 2596		1									
108-82	ATJ 50 0628	Irst. Impr. Weather Mapping Radar							1	1	1	
130-82	AAC 50 0636											
6-83	AAC 50 0602			1								
101-83	AHB 50 0296											
101-83	YCA 54 2692						1					
104-83	QAE 54 2691		1									
114-83	AHB 50 0297	AFC to install AVC 2658										
114-83	YCA 54 2658	AVC to AN/APN-182										
117-84	ACM 50 0291			1								

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	O&I	ALSO IN PROD	AIRCRAFT TYPE F/A	AEW	ASW	HELO	CARGO	INSTALLATION TYPE COMM	NAV	ID	ECM	ESM	RADAR
27-70	VCM 50 0210	1						1	1					
7-72	AAR 50 0461			1										2
7-72	AAC 50 0555			1						1				2
7-72	AFP 50 057C	1		1								1		
53-72	APB 50 0401					1								
53-72	APB 50 0410					1								
53-72	AFB 50 0233					1								
53-72	APB 50 0404					1								
53-72	APB 50 0326					1				1				
31-73	YCA 54 2345			1										
31-73	YCA 54 2496			1										
48-74	AAF 50 0405	1		1						1				
48-74	AAF 50 0409			1						1				
5-75	AAF 50 0350		N	1					1					
5-75	AAF 50 0382		Y	1					1					
28-75	ACM 50 0246				1				1					
1-76	AAR 50 0493	1		1								1		
1-77	YCA 54 2233			1										
1-77	YCA 54 2232			1						1				
1-77	AAC 50 0567			1										
10-77	AAR 50 0482	1			1					1				
10-77	AAE 50 0454				1				1	1	1			
8-78	AHB 50 0281						1		1					
8-78	YCA 54 2628						1							
8-78	AHB 50 0267						1			1				
8-78	AHB 50 0267	1					1		1					
8-78	AHB 50 0283	1					1						1	
8-73	AHB 50 0269	1					1			1				2
8-78	AHB 54 2533						1		1					
8-78	AHB 50 0274	1					1		1					
22-78	APB 50 0350					1			1					
22-78	APB 50 0395					1			1					
21-79	AAF 50 0483		Y		1							1		
22-79	YCA 54 2537				1							1		
22-79	AAE 50 0472				1							1		
23-79	AAF 50 0412				1					1				
23-79	AAF 50 0396				1					1				
23-79	AAF 50 0401				1					1				2
23-79	AAF 50 0390				1					1				
23-79	AAF 50 0389				1				1					
25-79	AAF 50 0387			1								1		
26-79	AAF 50 0411		N	1								1		
30-79	YCA 54 2277			1										2
63-79	AYH 50 0082		N			1						1		
66-79	AHR 50 0339						1					1		
68-79	AHX 50 0277		N				1					1		
68-79	AHX 50 0277		N				1					1		

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	O&I	ALSO IN PROD	AIRCRAFT TYPE F/A	AEW	ASW	HELO	CARGO	INSTALLATION TYPE COMM	NAV	ID	ECM	ESM	RADAR
102-79	YCA 54 2479	1				1								
104-79	YCA 54 2693	1				1								
104-79	YCA 56 0749					1								
104-79	APB 50 0405		N			1								
104-79	APB 50 0406	1				1								
104-79	APB 50 0402	1				1								
104-79	APB 50 0388		N			1								
13-80	AAF 50 0421			1										
15-80	YCA 54 2427		N	1										
15-80	QAF 50 0410		N	1								1		
18-80	YCA 54 2548	1		1										
18-80	YCA 54 2751	1		1					1					
19-81	YCA 54 2523			1										
47-81	YCA 54 2562/3		N			1				1				
47-81	AP3 50 0408		N			1				1				
47-81	AP3 50 0414		N			1				1				
100-81	AAB 50 0500				1					1				2
100-81	AAB 50 0501				1				1	1				
21-82	AHR 50 0345		N				1			1				
31-82	APB 50 0427					1								
49-82	AEB 50 0303		Y		1								1	
51-82	YCA 54 2588	1	Y	1						1				2
60-82	AFP 50 0660		N	1					1					
62-82	AFW 50 0670		Y	1										
62-82	YCA 54 2564/65/66		Y	1										
62-82	AFW 50 0668		Y	1										
62-82	VFU 50 0671			1										
71-82	APB 50 0424					1			1					
78-82	YCA 54 2597		N	1	1	1		1		1				
89-82	AAS 50 0551	1	N	1						1				
90-82	YCA 54 2596		Y	1	1	1	1	1			1			
108-82	ATJ 50 0628		N					1		1				2
130-82	AAC 50 0636	1		1						1				
6-83	AAC 50 0602		N	1						1				
101-83	AHB 50 0296	1					1			1				
101-83	YCA 54 2692						1			1				
104-83	QAS 54 2691		N	1	1	1	1			1				
114-83	AHB 50 0297	1	N				1			1				2
114-83	YCA 54 2658	1	N				1			1				2
117-84	ACM 50 0291		Y					1	1					

OSIP #	TDN	E-O	MISSILE	ARM	SURV	F/C	MISC	WING STATION OR POD MOUNT	AIRCRAFT	OSIP SRCE.(FY)
27-70	VCM 50 0210									
7-72	AAE 50 0461	2			1					
7-72	AAC 50 0555									
7-72	AFP 50 0570									
53-72	APB 50 0401			1			sonobuoy launch			
53-72	APB 50 0410						sonar			
53-72	AFB 50 0233						structural			
53-72	APB 50 0404						data bus/record			
53-72	APB 50 0326									
31-73	YCA 54 2345		2			1				
31-73	YCA 54 2496		2			1				
48-74	AAF 50 0405									
48-74	AAF 50 0409									
5-75	AAF 50 0350								A-7A/B	81
5-75	AAF 50 0382								A-7E	81
28-75	ACM 50 0246									
1-76	AAE 50 0493									
1-77	YCA 54 2233						bombing			
1-77	YCA 54 2232									
1-77	AAC 50 0567						bombing			
10-77	AAE 50 0482									
10-77	AAE 50 0454									
8-78	AHB 50 0281									
8-78	YCA 54 2628				1		MAD			
8-78	AHB 50 0267									
8-78	AHB 50 0267									
8-78	AHB 50 0283									
8-78	AHB 50 0269									
8-78	AHB 54 2533									
8-78	AHB 50 0274									
22-78	APB 50 0350									
22-78	APB 50 0395									
21-79	AAF 50 0483							2	RA-6B	81
22-79	YCA 54 2537									
22-79	AAE 50 0472									
23-79	AAF 50 0412						Deice			
23-79	AAF 50 0396						AFCS			
23-79	AAF 50 0401									
23-79	AAF 50 0390	2								
23-79	AAF 50 0389	2	2				Computer			
25-79	AAF 50 0387									
26-79	AAF 50 0411								A-7E	85
30-79	YCA 54 2277					1				
63-79	AYH 50 0082								OV-10A/D	81
68-79	AHR 50 0339									
68-79	AHX 50 0277								CH-53A/D	83
68-79	AHX 50 0277								CH-53A/D	83

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	E-O	MISSILE	ARM	SURV	F/C	MISC	WING STATION OR POD MOUNT	AIRCRAFT	OSIP SRCE.(FY)
102-79	YCA 54 2479	1			1					
104-79	YCA 54 2693		1			1				
104-79	YCA 56 0749			1			Pylon	2		
104-79	APB 50 0405		2	1				2	P-3C	88
104-79	APB 50 0406			1			Pylon	2		
104-79	APB 50 0402		1							
104-79	APB 50 0388		2	1		1	Pylons/AWG	2	P-3B	88
13-80	AAF 50 0421		2			1				
15-80	YCA 54 2427	2							A-7E/TA-7C	84
15-80	QAF 50 0410	2							A-7E/TA-7C	84
18-80	YCA 54 2548		2			1				
18-80	YCA 54 2751		2							
19-81	YCA 54 2523		2			1				
47-81	YCA 54 2562/3								P-3C	84
47-81	APB 50 0408								P-3C	84
47-81	APR 50 0414								P-3C	84
100-81	AAB 50 0500									
100-81	AAB 50 0501									
21-82	AHR 50 0345								HH-46A,CH-46	85
31-82	APB 50 0427				1		MAD			
49-82	AEB 50 0303								E-2C	86
51-82	YCA 54 2588				1	1	Multimode		A-6E	84
80-82	AFP 50 0660								F-4S	85
62-82	AFW 50 0670	2			1		TV/Record		F-14A	86
62-82	YCA 54 2564/65/66	1							F-14A	66
62-82	AFW 50 0668	2			1		TV		F-14A	86
62-82	VFU 50 0671	2			1		TV			
71-82	APB 50 0424									
78-82	YCA 54 2597								Various	84
89-82	AAE 50 0551								Var	86
90-82	YCA 54 2596								Var	84
108-82	ATJ 50 0628								CT-39E/G	84
130-82	AAC 50 0636									
6-83	AAC 50 0602								TA-4F/TA-4J	86
101-83	AHB 50 0296									
101-83	YCA 54 2692									
104-83	QAE 54 2691								Var	86
114-83	AHB 50 0297								H-2	86
114-83	YCA 54 2658								Var Helicopt	86
117-84	ACM 50 0291								C-130F,KC-13	87

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	NON-RECURRING 84$K	ENG DEV/ DESIGN/ TEST	TOOLING	NRE 84$K	TECH. DIR. PREP.	TECH. DIR. P&P	DRAWINGS	TEST 84$K	DATA/ PUBS 84$K	PUBLI-CATIONS
27-70	VCM 50 0210										
7-72	AAE 50 0461										
7-72	AAC 50 0555										
7-72	AFP 50 0570										
53-72	APB 50 0401										
53-72	APB 50 0410										
53-72	AFB 50 0233										
53-72	APB 50 0404										
53-72	APB 50 0326										
31-73	YCA 54 2345										
31-73	YCA 54 2496										
48-74	AAF 50 0405										
48-74	AAF 50 0409										
5-75	AAF 50 0350	72	18.2		18.2	1.4	0.4			52	43.3
5-75	AAF 50 0382	459	58		24.2	45.4	0.05	86	33.8	270	235
28-75	ACM 50 0246										
1-76	AAE 50 0493										
1-77	YCA 54 2233										
1-77	YCA 54 2232										
1-77	AAC 50 0567										
10-77	AAE 50 0482										
10-77	AAE 50 0454										
8-78	AHB 50 0281										
8-78	YCA 54 2628										
8-78	AHB 50 0267										
8-78	AHB 50 0267										
8-78	AHB 50 0283										
8-78	AHB 50 0269										
8-78	AHB 54 2533										
8-78	AHB 50 0274										
22-78	APB 50 0350										
22-78	APB 50 0395										
21-79	AAF 50 0483	301	145.3			75.9	0.4	0		29.6	
22-79	YCA 54 2537										
22-79	AAE 50 0472										
23-79	AAF 50 0412										
23-79	AAF 50 0396										
23-79	AAF 50 0401										
23-79	AAF 50 0390										
23-79	AAF 50 0389										
25-79	AAF 50 0387										
26-79	AAF 50 0411	3071	2681	175	1823	10	0.38		683	152	
30-79	YCA 54 2277										
63-79	AYH 50 0082				759						
66-79	AHR 50 0339										
68-79	AHX 50 0277				14				13		
[illegible]	[illegible] 50 0277				164				152		

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NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	NON-RECURRING 84$K	ENG DEV/ DESIGN/ TEST	TOOLING	NRE 84$K	TECH. DIR. PREP.	TECH. DIR. P&P	DRAWINGS	TEST 84$K	DATA/ PUBS 84$K	PUBLI-CATIONS
102-79	YCA 54 2479										
104-79	YCA 54 2693										
104-79	YCA 56 0749										
104-79	APB 50 0405	657	229	34	195						428
104-79	APB 50 0406										
104-79	APB 50 0402										
104-79	APB 50 0388	1571	1111	23	1005				83		338
13-80	AAF 50 0421										
15-80	YCA 54 2427		1206.9			27.6					
15-80	QAF 50 0410		1206.9			27.6					
18-80	YCA 54 2548										
18-80	YCA 54 2751										
19-81	YCA 54 2523										
47-81	YCA 54 2562/3	25.5	17.3			2.8	0.01			5.5	5
47-81	APB 50 0408	1055	551			233.4	0.6		57	213	192
47-81	APB 50 0414	1021.9	690.8			110.1	0.414			220.5	199
100-81	AAB 50 0500										
100-81	AAB 50 0501										
21-82	AHR 50 0345	34			34						
31-82	APB 50 0427										
49-82	AEB 50 0303	921			921						
51-82	YCA 54 2588		352.4			3.6					
60-82	AFP 50 0660	800	694.7			46	0.4		234	65	58.2
62-82	AFW 50 0670										
62-82	YCA 54 2564/65/66					26					
62-82	AFW 50 0668										
62-82	VFU 50 0671										
71-82	APB 50 0424										
78-82	YCA 54 2597										
89-82	AAB 50 0551										
90-82	YCA 54 2596	154	94.9			3.4	0.7			56	56
108-82	ATJ 50 0628							2			
130-82	AAC 50 0636										
6-83	AAC 50 0602	8			8						
101-83	AHB 50 0296										
101-83	YCA 54 2692										
104-83	QAR 54 2691	206	160.4			8.5	0.5	12.7		23.4	21.2
114-83	AHB 50 0297	16.4	2.1			9.5	1.3			3.5	3.1
114-83	YCA 54 2658	379	312.4			4.7	0.53			61.6	56
117-84	ACM 50 0291										

OSIP #	TD#	PUBS PRINTING	ILS 84$K	KITS-CAC OR AVE 84$K	KITS TOTAL 84$K	H/W-CAC OR AVE 84$K	H/W TOTAL 84$K	H/W INCL IN KITS? (Y/N)	REP'T. INSTALL MHRS (HRS)	REP'T. INSTALL MHRS@100 (HRS)	EST'D. INSTALL MHRS (HRS)	% STRUCT
27-70	VCM 50 0210			20.3						4.89	26	
7-72	AAE 50 0461			0.2						13.91	40	
7-72	AAC 50 0555			0.1						8.94	17	7
7-72	AFP 50 0570			0.1						21.8	40	100
53-72	APB 50 0401									20.18	25	
53-72	APB 50 0410									139.89	160	100
53-72	AFB 50 0233									4.73	16	
53-72	APB 50 0404									51.09	60	50
53-72	APB 50 0326									567.16	850	
31-73	YCA 54 2345			791.0						2.11	8	
31-73	YCA 54 2496									2.32	202	
48-74	AAF 50 0405									7.01	6	
48-74	AAF 50 0409									8.08	6	
5-75	AAF 50 0350	8.7		0.8	143.0	19	3482	N	15.3	12.83	16	
5-75	AAF 50 0382	34.8		7.7		31		N	115.6	138.22	115	6
28-75	ACM 50 0246									1.57	1	
1-78	AAE 50 0493									13.55	9	6
1-77	YCA 54 2233			0.0						8.42	10	
1-77	YCA 54 2232			1.4						7.58	9	
1-77	AAC 50 0567			199.6						465.32	500	42
10-77	AAE 50 0482									5.01	9	
10-77	AAE 50 0454									716.25	1981	
8-73	AHB 50 0281			2.1						13.73	28	29
8-73	YCA 54 2628									4.9	40	
8-73	AHB 50 0267									678.46	840	48
8-73	AHB 50 0267			159.9						4.95	6	
8-73	AHB 50 0283			6.1						1.56	1	
8-73	AHB 50 0269			0.2						5.29	3	67
8-73	AHB 54 2533			54.2						0.86	12	
8-73	AHB 50 0274									1.17	2	
22-78	APB 50 0350			2.1						29.89	96	33
22-78	APB 50 0395			12.9						178.13	226	12
21-79	AAF 50 0483			11.2				N	212.8	175.46	350	54
22-79	YCA 54 2537									28.59	2	
22-79	AAE 50 0472			11.0						81.52	192	17
23-79	AAF 50 0412									4.9	16	25
23-79	AAF 50 0396			0.2						11.22	22	
23-79	AAF 50 0401			0.1						5.94	16	
23-79	AAF 50 0390			92.2						32.05	27	
23-79	AAF 50 0389			117.9						1160.97	905	40
25-79	AAF 50 0387			0.8						69.91	60	16
26-79	AAF 50 0411		228	33.0		133		N	168	237	320	
30-79	YCA 54 2277									10.14	30	
63-79	AYH 50 0082			25.0				N	129.18	111.71	320	38
66-79	AHR 50 0339			20.0						535.15	360	
68-79	AHX 50 0277			0.8				N	10.4	12.61	32	
68-79	AHX 50 0277			10.0		17		N	123.11	145.71	415	71

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	PUBS PRINTING	ILS 84$K	KITS-CAC OR AVE 84$K	KITS TOTAL 84$K	H/W-CAC OR AVE 84$K	H/W TOTAL 84$K	H/W INCL IN KITS? (Y/N)	REP'T. INSTALL MHRS (HRS)	REP'T. INSTALL MHRS@100 (HRS)	EST'D. INSTALL MHRS (HRS)	% STRUCT
102-79	YCA 54 2479			210.0						3.35	4	
104-79	YCA 54 2693			0.1						1.37	1	
104-79	YCA 56 0749			28.6						5.85	125	92
104-79	APB 50 0405			62.0		262		N	742	735	880	
104-79	APB 50 0406			76.4						3.1	4	100
104-79	APB 50 0402			2.5						7.21	26	
104-79	APB 50 0388		123	133.0		262		N			538	
13-80	AAF 50 0421			83.2						130.94	312	6
15-80	YCA 54 2427							N			28	
15-80	QAF 50 0410			9.7		98.79		N	15	31.21	52	
18-80	YCA 54 2548									4.7	8	
18-80	YCA 54 2751									1.68	1	
19-81	YCA 54 2523			41.5						32.87	32	
47-81	YCA 54 2562/3	0.5		0.1				N			16	
47-81	APB 50 0408	21		117.0		159		N	928	817	1490	60
47-81	APB 50 0414	21.5		8.9		25		N	269.25	280.35	300	
100-81	AAB 50 0500									37.72	32	50
100-81	AAB 50 0501									70.72	36	33
21-82	AHR 50 0345					21		Y	3.57	3.86	3	63
31-82	APB 50 0427			13.3						431.97	477	79
49-82	AEB 50 0303			758.0		123		N	266.7	228.3	800	50
51-82	YCA 54 2588			28.7				N	4.2	4.11	1	
60-82	AFP 50 0660	6.8		21.0		50		N	50.6	97.5	153	
62-82	AFW 50 0670			5.1		197		N	97	149	174	28
62-82	YCA 54 2564/65/66			11				N				
62-82	AFW 50 0668			5.9				N	126	391	66	24
62-82	VFU 50 0671											
71-82	APB 50 0424			7.5						244.3	288	31
78-82	YCA 54 2597			0.6				N			11	
89-82	AAE 50 0551					1.1		Y	1.4	1.7	2	
90-82	YCA 54 2596			0.3				N	5	4.08	41	
108-82	ATJ 50 0628					36		Y	116	69.3	150	
130-82	AAC 50 0636			0.2						3.74	4	50
6-83	AAC 50 0602			1.0		21		N	0.89	1.14	7	
101-83	AHB 50 0296									0.76	1	
101-83	YCA 54 2692			6.0						2.64	1	
104-83	QAE 54 2691	2.1		0.7				N	23	9.14	23	
114-83	AHB 50 0297	0.4							2.9	2.9	5	
114-83	YCA 54 2658	5.6		9.8					6.7	5.9	9.3	
117-84	ACM 50 0291			51.0		79		N	40	15.03	160	

OSIP #	TD#	% MECH.	% ELECTR.	TRAINER INSTALL MHRS@100 (HRS)	SPARES INSTALL MHRS@100 (HRS)	INSTALL CAC OR AVE $84K	REFURBISH UPDATE 84$K	PSE	PSE ENGR 84$K
27-70	VCM 50 0210		100						
7-72	AAE 50 0461								
7-72	AAC 50 0555	0	93						
7-72	AFP 50 0570								
53-72	APB 50 0401					1.8			
53-72	APB 50 0410					10.9			
53-72	AFB 50 0233	100				0.4			
53-72	APB 50 0404		50			4			
53-72	APB 50 0326					44.3			
31-73	YCA 54 2345		100						
31-73	YCA 54 2496		100						
48-74	AAF 50 0405		100						
48-74	AAF 50 0409		100						
5-75	AAF 50 0350		100		0.57	0.57	0	0	0
5-75	AAF 50 0382		94		6.09	6.47	0	0	0
28-75	ACM 50 0246		100						
1-76	AAE 50 0493		94						
1-77	YCA 54 2233		100			1			
1-77	YCA 54 2232		100			0.9			
1-77	AAC 50 0567		58			55.1			
10-77	AAE 50 0482		100			2			
10-77	AAE 50 0454	21	79			235			
8-78	AHB 50 0281		71						
8-78	YCA 54 2628		100						
8-78	AHB 50 0267		52						
8-78	AHB 50 0267		100						
8-78	AHB 50 0283		100						
8-78	AHB 50 0269		33						
8-78	AHB 54 2533		100						
8-78	AHB 50 0274		100						
22-78	APB 50 0350		67			3.4			
22-78	APB 50 0395		88			14.6			
21-79	AAF 50 0483		48				0		
22-79	YCA 54 2537		100						
22-79	AAE 50 0472		83						
23-79	AAF 50 0412		75						
23-79	AAF 50 0396		100						
23-79	AAF 50 0401		100						
23-79	AAF 50 0390		100						
23-79	AAF 50 0389		60						
25-79	AAF 50 0387	84							
26-79	AAF 50 0411				20			7898	
30-79	YCA 54 2277		100						
63-79	AYH 50 0082		63		16				
66-79	AHR 50 0339	50	50						
68-79	AHY 50 0277								

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	% MECH.	% ELECTR.	TRAINER INSTALL MHRS@100 (HRS)	SPARES INSTALL MHRS@100 (HRS)	INSTALL CAC OR AVE $84K	RECURRING ENGR 4$K	S/W AVE	REFURBISH UPDATE 84$K	PSE	PSE ENGR 84$K
102-79	YCA 54 2479		100								
104-79	YCA 54 2693		100								
104-79	YCA 56 0749	8									
104-79	APB 50 0405				132						
104-79	APB 50 0406										
104-79	APB 50 0402	9	91								
104-79	AFB 50 0388				113						
13-80	AAF 50 0421		94								
15-80	YCA 54 2427		100						0		
15-80	QAF 50 0410								0		
18-80	YCA 54 2548		100			1.42					
18-80	YCA 54 2751		100			0.51					
19-81	YCA 54 2523										
47-81	YCA 54 2562/3										
47-81	APB 50 0408		40								
47-81	APB 50 0414										
100-81	AAB 50 0500		50								
100-81	AAB 50 0501		67								
21-82	AHR 50 0345		38		2.2						
31-82	APB 50 0427		21								
49-82	ABB 50 0303		50		388						
51-82	YCA 54 2588		100	2.2							
60-82	AFP 50 0660	38	62		6						
62-82	AFW 50 0670		72			4					
62-82	YCA 54 2564/65/66					21.2					
62-82	AFW 50 0668		76			17					
62-82	VPU 50 0671										
71-82	APB 50 0424		69								
78-82	YCA 54 2597										
89-82	AAE 50 0551		100								
90-82	YCA 54 2596		100		1.5						
108-82	ATJ 50 0628				8						
130-82	AAC 50 0636		50								
6-83	AAC 50 0602		100								
101-83	AHB 50 0296		100			0.7					
101-83	YCA 54 2692		100			2.4					
104-83	QAE 54 2691				1.6						
114-83	AHB 50 0297										
114-83	YCA 54 2658		100	6.3							
117-84	ACM 50 0291										

OSIP #	TD#	TRAINER 84$K	OPER. FLT TRAINER KIT AVE 84$K	WST TRAINER KIT AVE 84$K	NAMT TRAINER KIT AVE 84$K	TRAINER ENGR 84$K	TRAINER MOD KITS 84$K	TRAINER H/W 84$K	SPARES 84$K	INSTAL-LATION 84$K
27-70	VCM 50 0210									
7-72	AAE 50 0461									
7-72	AAC 50 0555									
7-72	AFP 50 0570									
53-72	APB 50 0401									
53-72	APB 50 0410									
53-72	AFB 50 0233									
53-72	APB 50 0404									
53-72	APB 50 0326									
31-73	YCA 54 2345									
31-73	YCA 54 2496									
48-74	AAF 50 0405									
48-74	AAF 50 0409									
5-75	AAF 50 0350	0				0	0	0	0	717
5-75	AAF 50 0382	0				0	0	0	0	5415
28-75	ACM 50 0246									
1-76	AAE 50 0493									
1-77	YCA 54 2233									
1-77	YCA 54 2232									
1-77	AAC 50 0567									
10-77	AAR 50 0482									
10-77	AAR 50 0454									
8-78	AHB 50 0281									
8-78	YCA 54 2628									
8-78	AHB 50 0267									
8-78	AHB 50 0267									
8-78	AHB 50 0283									
8-78	AHB 50 0269									
8-78	AHB 54 2533									
8-78	AHB 50 0274									
22-78	APB 50 0350									
22-78	APB 50 0395									
21-79	AAF 50 0483	0				0	0	0		
22-79	YCA 54 2537									
22-79	AAE 50 0472									
23-79	AAF 50 0412									
23-79	AAF 50 0398									
23-79	AAF 50 0401									
23-79	AAF 50 0390									
23-79	AAF 50 0389									
25-79	AAF 50 0387									
26-79	AAF 50 0411			268.5			637			
30-79	YCA 54 2277									
63-79	AYH 50 0082	0				0	0	0	62	652
66-79	AHR 50 0339									
68-79	AHX 50 0277									
			338		1		338			

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	TRAINER 84$K	OPER. FLT TRAINER KIT AVE 84$K	WST TRAINER KIT AVE 84$K	NAMT TRAINER KIT AVE 84$K	TRAINER ENGR 84$K	TRAINER MOD KITS 84$K	TRAINER H/W 84$K	SPARES 84$K	INSTAL-LATION 84$K
102-79	YCA 54 2479									
104-79	YCA 54 2693									
104-79	YCA 56 0749									
104-79	APB 50 0405								24	
104-79	APB 50 0406									
104-79	APB 50 0402									
104-79	APB 50 0388								734	
13-80	AAF 50 0421									
15-80	YCA 54 2427									
15-80	QAF 50 0410	126							255	
18-80	YCA 54 2548									
18-80	YCA 54 2751									
19-81	YCA 54 2523									
47-81	YCA 54 2562/3				0.6		0.6			
47-81	APB 50 0408									
47-81	APB 50 0414			220.4	49		539.4			
100-81	AAB 50 0500									
100-81	AAB 50 0501									
21-82	AHR 50 0345	83						83		
31-82	APB 50 0427									
49-82	AEB 50 0303								5867	
51-82	YCA 54 2588									
60-82	AFP 50 0660			45.8		57			165	
62-82	AFW 50 0670									
62-82	YCA 54 2564/65/66									
62-82	AFW 50 0668									
62-82	VFU 50 0671									
71-82	AFB 50 0424									
78-82	YCA 54 2597									
89-82	AAE 50 0551								33	
90-82	YCA 54 2596									
108-82	ATJ 50 0628									
130-82	AAC 50 0636									
6-83	AAC 50 0602	34			1		4	30		
101-83	AHB 50 0296									
101-83	YCA 54 2692									
104-83	QAE 54 2691	11					11			
114-83	AHB 50 0297									
114-83	YCA 54 2658	124		9.3	11.3		124			
117-84	ACM 50 0291									

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	UNIT WT.	EMPTY WT.	AVIONICS EQUIP. WT.	AVIONICS INSTALL. WT.	ELECTRIC GRP. WT.	LAU/RACK/ PYLON WT.	FUSELAGE VOL.	
27-70	VCH 50 0210	54597	72802	1340	931	3607		9060	
7-72	AAE 50 0461	41784	58814	3629	2008	1717	105	8272	
7-72	AAC 50 0555	41784	58814	3629	2008	1717	105	8272	
7-72	AFP 50 0570	41784	58814	3629	2008	1717	105	8272	
53-72	APB 50 0401	41697	59638	3754	2094	1778	104	8272	
53-72	APB 50 0410	41697	59638	3754	2094	1778	104	8272	
53-72	AFB 50 0233	41697	59638	3754	2094	1778	104	8272	
53-72	APB 50 0404	41697	59638	3754	2094	1778	104	8272	
53-72	APB 50 0326	41697	59638	3754	2094	1778	104	8272	
31-73	YCA 54 2345	17901	25562	1847	662	762	610	1280	
31-73	YCA 54 2496	17901	25562	1847	662	762	610	1280	
48-74	AAF 50 0405	13630	18979	1155	168	1145	1842	950	
48-74	AAF 50 0409	13630	18979	1155	168	1145	1842	950	
5-75	AAF 50 0350	11564	16080	795	88	822	1829	950	2
5-75	AAF 50 0382	13630	18979	1155	168	1145	1842	950	2
28-75	ACM 50 0246	54597	72802	1340	931	3607		9060	
1-76	AAE 50 0493	17901	25562	1847	662	762	610	1280	
1-77	YCA 54 2233	7724	10332	183	441	347	78	565	
1-77	YCA 54 2232	7724	10332	183	441	347	78	565	
1-77	AAC 50 0567	7724	10332	183	441	347	78	565	
10-77	AAE 50 0482	19250	27934	3200	2007	715	650	7280	
10-77	AAE 50 0454	19250	27934	3200	2007	715	650	7280	
8-78	AHB 50 0281	6476	8653	846	267	311		722	
8-78	YCA 64 2628	6476	8653	846	267	311		722	
8-78	AHB 50 0267	6476	8653	846	267	311		722	
8-78	AHB 50 0267	6476	8653	846	267	311		722	
8-78	AHB 50 0283	6476	8653	846	267	311		722	
8-78	AHB 50 0269	6476	8653	846	267	311		722	
8-78	AHB 54 2533	6476	8653	846	267	311		722	
8-78	AHB 50 0274	6476	8653	846	267	311		722	
22-78	APB 50 0350	44612	66198	6452	3684	1923	1299	7745	
22-78	APB 50 0395	44612	66198	6452	3684	1923	1299	7745	
21-79	AAF 50 0483	22727	32120	3379	1512	773	606	1410	0
22-79	YCA 54 2537	22727	32120	3379	1512	773	606	1410	
22-79	AAE 50 0472	22727	32120	3379	1512	773	606	1410	
23-79	AAF 50 0412	13630	18979	1155	168	1145	1842	950	
23-79	AAF 50 0396	13630	18979	1155	168	1145	1842	950	
23-79	AAF 50 0401	13630	18979	1155	168	1145	1842	950	
23-79	AAF 50 0390	13630	18979	1155	168	1145	1842	950	
23-79	AAF 50 0389	13630	18979	1155	163	1145	1842	950	
25-79	AAF 50 0387	12626	17620	998	135	996	2239	950	
26-79	AAF 50 0411	13630	18979	1155	168	1145	1842	950	
30-79	YCA 54 2277	19927	30778	1867	1029	500			
63-79	AYH 50 0082	5044	6921		323				0
66-79	AHR 50 0339	11701	12971	389	106	641		1480	
68-79	AHX 50 0277	20047	23313	411	256	611			
68-79	AHX 50 0277	20047	23313	411	256	611			

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	UNIT WT.	EMPTY WT.	AVIONICS EQUIP. WT.	AVIONICS INSTALL. WT.	ELECTRIC GRP. WT.	LAU/RACK/ PYLON WT.	FUSELAGE VOL.
102-79	YCA 54 2479	19248	26366	3158	1016	726	400	1780
104-79	YCA 54 2693	41610	60461	3880	2180	1838	102	8272
104-79	YCA 56 0749	41610	60461	3880	2180	1838	102	8272
104-79	AFB 50 0405	44612	66198	6452	3684	1923	1299	7745
104-79	AFB 50 0406	41610	60461	3880	2180	1838	102	8272
104-79	AFB 50 0402	41610	60461	3880	2180	1838	102	8272
104-79	AFB 50 0388	41610	60461	3880	2180	1838	102	8272
13-80	AAF 50 0421	13630	18979	1155	168	1145	950	
15-80	YCA 54 2427	13630	18979	1155	168	1145	1842	950
15-80	QAF 50 0410	13630	18979	1155	168	1145	1842	950
18-80	YCA 54 2548	13630	18979	1155	168	1145	950	
18-80	YCA 54 2751	13630	18979	1155	168	1145	950	
19-81	YCA 54 2523	19927	30778	1867	1029	500		1428
47-81	YCA 54 2562/3	44612	66198	6542	3684	1923	1299	7745
47-81	APB 50 0408	44612	66198	6542	3684	1923	1299	7745
47-81	APB 50 0414	44612	66198	6542	3684	1923	1299	7745
100-81	AAB 50 0500		41954	1632	1164	982		2537
100-81	AAB 50 0501		41954	1632	1164	982		2537
21-82	AHR 50 0345	11100	12971	389	106	641		1460
31-82	APB 50 0427	44612	66198	6542	3684	1923	1299	7745
49-82	AEB 50 0303	22701	37678	9544	1940	936		1347
51-82	YCA 54 2588	17901	25562	1847	662	762	610	1280
60-82	AFP 50 0660	19927	30778	1867	1029	500		1428
62-82	AFW 50 0670	26505	38189	2382	599	779	288	3340
62-82	YCA 54 2564/65/66	26505	38189	2382	599	779	288	3340
62-82	AFW 50 0668	26505	38189	2382	599	779	288	3340
62-82	VFU 50 0671	26505	38189	2382	599	779	288	3340
71-82	APB 50 0424	44612	66198	6542	3684	1923	1299	7745
78-82	YCA 54 2597							
89-82	AAE 50 0551							
90-82	YCA 54 2596							
108-82	ATJ 50 0628	7727	10092	757	370	847		865
130-82	AAC 50 0636		10696	385	160	296		606
6-83	AAC 50 0602		10696	385	160	296		606
101-83	AHB 50 0296							
101-83	YCA 54 2692							
104-83	QAE 54 2691							
114-83	AHB 50 0297	11166	13987	1917.8	659.5	475.5	40	2927
114-83	YCA 54 2658							
117-84	ACM 50 0291		74378	1523.4	881.5	2574.3	1825	

OSIP #	TD#	NO. AIRFRAME TDs	NO. AVIONICS TDs	NO. ARMAMENT TDs	NO. SUPT. EQ. TDs		NO. OTHER TDs	NO. BASIC A KITS	NO. SPARES B KITS	NO. TRAINER E/K KITS	NO. OTHER KITS	NO. BOXES INSTALL.
27-70	VCM 50 0210											0
7-72	AAR 50 0461											1
7-72	AAC 50 0555											1
7-72	AFP 50 0570											0
53-72	APB 50 0401											0
53-72	APB 50 0410											0
53-72	APB 50 0233											0
53-72	APB 50 0404											0
53-72	APB 50 0326											5
31-73	YCA 54 2345											0
31-73	YCA 54 2496											0
48-74	AAF 50 0405											1
48-74	AAF 50 0409											1
5-75	AAF 50 0350	1	0	0	0	Y	0	1	0	0	0	1
5-75	AAF 50 0382	1	0	0	0	Y	0	1	0	0	0	2
28-75	ACM 50 0246											0
1-76	AAE 50 0493											2
1-77	YCA 54 2233											0
1-77	YCA 54 2232											0
1-77	AAC 50 0567											1
10-77	AAE 50 0482											0
10-77	AAB 50 0454											4
8-78	AHB 50 0281											0
8-78	YCA 54 2628											0
8-78	AHB 50 0267											1
8-78	AHB 50 0267											0
8-78	AHB 50 0283											0
8-78	AHB 50 0269											0
8-78	AHB 54 2533											0
8-78	AHB 50 0274											2
22-78	APB 50 0350											0
22-78	APB 50 0395											0
21-79	AAF 50 0483	1	0	0	0	Y	0	1	0	0	0	1
22-79	YCA 54 2537											0
22-79	AAB 50 0472											0
23-79	AAF 50 0412											0
23-79	AAF 50 0396											0
23-79	AAF 50 0401											0
23-79	AAF 50 0390											0
23-79	AAF 50 0389											0
25-79	AAF 50 0387											0
26-79	AAF 50 0411	1	1	0	0	Y	0	1	1	1	0	3
30-79	YCA 54 2277											0
63-79	AYH 50 0082	1	0	0	0	Y	0	2	0	0	0	1
												2

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	NO. AIRFRAME TDs	NO. AVIONICS TDs	NO. ARMAMENT TDs	NO. SUPT. EQ. TDs	NO. OTHER TDs	NO. BASIC A KITS	NO. SPARES B KITS	NO. TRAINER B/K KITS	NO. OTHER KITS	NO. BOXES INSTALL.
102-79	YCA 54 2479										0
104-79	YCA 54 2693										0
104-79	YCA 56 0749										0
104-79	APB 50 0405	1	0	0	0 Y	0	1	0	0	0	1
104-79	APB 50 0406										0
104-79	APB 50 0402										0
104-79	APB 50 0388	1	0	0	0 Y	4	3	0	0	0	2
13-80	AAF 50 0421										1
15-80	YCA 54 2427	0	1	0	0 Y	0	3	3	0	0	0
15-80	QAF 50 0410	1	0	0	0 Y	0	1	0	2	0	1
18-80	YCA 54 2548										0
18-80	YCA 54 2751										0
19-81	YCA 54 2523										0
47-81	YCA 54 2562/3	0	2	0	0 Y	0	2	2	1	0	0
47-81	APB 50 0408	1	0	0	0 Y	0	2	0	1	0	2
47-81	APB 50 0414	1	0	0	0 Y	0	1	0	1	0	1
100-81	AAB 50 0500										1
100-81	AAB 50 0501										3
21-82	AHR 50 0345	1	0	0	0 Y	0	0	0	0	0	1
31-82	AFB 50 0427										0
49-82	AEB 50 0303	1	0	0	0 Y	0	1	0	0	0	0
51-82	YCA 54 2586	0	1	0	0 Y	0	2	1	1	0	0
60-82	AFP 50 0660	1	0	0	0 Y	0	1	2	0	0	2
62-82	AFW 50 0670	2	0	0	0 Y	0	1	1	0	0	2
62-82	YCA 54 2564/65/66	0	3	0	2 N	0	7	0	0	0	0
62-82	AFW 50 0668	1	0	0	0 Y	0	1	0	0	0	1
62-82	VFU 50 0671										1
71-82	AFB 50 0424										1
78-82	YCA 54 2597	0	1	0	0 Y	0	1	0	0	0	0
89-82	AAK 50 0551	1	0	0	0 Y	0	0	0	0	0	0
90-82	YCA 54 2596	0	1	0	0 Y	0	1	1	1	0	0
108-82	ATJ 50 0628	1	0	0	0 Y	0	0	0	0	0	1
130-82	AAC 50 0636										0
6-83	AAC 50 0602	1	0	0	0 Y	0	1	0	1	0	1
101-83	AHB 50 0296										0
101-83	YCA 54 2692										0
104-83	QAE 54 2691	0	1	0	0 Y	0	6	6	6	0	0
114-83	AHB 50 0297	1	0	0	0 Y	0	0	0	0	0	0
114-83	YCA 54 2658	0	1	0	0 Y	0	3	5	2	0	0
117-84	ACM 50 0291	1	0	0	0 Y	0	1	0	0	0	1

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	NO. BOXES REMOVED	NO. BOXES MOD'ED	NO. UNITS INSTALL.	NO. UNITS REMOVED	NO. UNITS MOD'ED	WT. TOTAL INSTALL.	WT. UNITS INSTALL.	WT. UNITS REMOVED	WT. HARDWARE INSTALL.	WT. HARDWARE REMOVED	WT. CABLES INSTALL.
27-70	VCM 50 0210	0	1	0	0	1						
7-72	AAE 50 0461	1	0	5		0	135	135	78	0	0	0
7-72	AAC 50 0555	1	0	4	5	0	10.95	8.95	14.8	2	1.5	0
7-72	AFP 50 0570	0	1	0	0	4	0	0	0	0	0	0
53-72	APB 50 0401	1	0	0	5	0	1.1	0	123	1.1	0	0
53-72	APB 50 0410	0	1	1	0	1			0		0	
53-72	AFB 50 0233	0	1	1	1	0	4.9	0	0	4.9	3	0
53-72	APB 50 0404	0	0	1	0	0	73	61	0	0	0	12
53-72	APB 50 0326	5	0	30	26	0	930.7	531.6	760.7	228.1	170.1	171
31-73	YCA 54 2345	0	1	0	0	1	0	0	0	0	0	0
31-73	YCA 54 2496	0	1	0	0	1	0	0	0	0	0	0
48-74	AAF 50 0405	1	0	4	3	0	56	50	47.25	6	6	0
48-74	AAF 50 0409	1	0	3	3	0	40	33	45.75	7	5.75	0
5-75	AAF 50 0350	1	0	3	5	0	20.7	13.2	34.7	3.5	0	2
5-75	AAF 50 0382	2	0	9	9	0	34.3	30.7	54.7	3.6	2	0
28-75	ACM 50 0246	0	1	0	0	1	0	0	0	0	0	0
1-76	AAE 50 0493	0	0	3	0	0	6	2.8	0	3.2	0	0
1-77	YCA 54 2233	0	1	0	0	1	0	0	0	0	0	0
1-77	YCA 54 2232	0	0	0	0	0	0	0	0	0	0	0
1-77	AAC 50 0567	2	0	8	11	0	202.5	81.3	151.5	121.2	101.8	0
10-77	AAE 50 0482	0	2	2	3	0	0	0	0	0	0	0
10-77	AAS 50 0454	2	0	21	15	0	285.2	116	394.9	169.6	161	0
8-78	AHB 50 0281	0	1	3	2	0	28.11	25.3	17.4	0.61	0	2.2
8-76	YCA 54 2628	0	1	0	0	1	0	0	0	0	0	0
8-78	AHB 50 0267	1	0	4	3	0	123.3	86	36	11.1	6.7	26.2
8-78	AHB 50 0267	0	0	0	0	0						
8-78	AHB 50 0283	0	1	0	0	2	0	0	0	0	0	0
8-78	AHB 50 0269	0	1	2	2	0	125.5	125.5	135.9	0	1.8	0
8-78	AHB 54 2533	0	1	0	0	2	0	0	0	0	0	0
8-78	AHB 50 0274	2	0	2	2	0	17	17	17	0	0	0
22-78	APB 50 0350	0	1	2	0	0	24.65	16.65	0	8	0	0
22-78	APB 50 0395	0	1	2	0	0	38.1	16.5	0	0	0	21.6
21-79	AAF 50 0483	0	0	6	0	0	24	4	0	7	1	14
22-79	YCA 54 2537	0	1	0	0	1	0	0	0	0	0	0
22-79	AAE 50 0472	0	1	4	4	0	23	13.5	10.4	1.5	1.3	8
23-79	AAF 50 0412	0	0	0	0	0						
23-79	AAF 50 0398	0	0	0	0	0	0	0	0	0	0	0
23-79	AAF 50 0401	0	0	0	0	0	0	0	0	0	0	0
23-79	AAF 50 0390	0	1	3	2	0	72	70.6	72	1.4	1.4	0
23-79	AAF 50 0389	0	1	1	1	2						
25-79	AAF 50 0387	0	0	4	4	0	20.5	13.5	9.2	0	0	0
26-79	AAF 50 0411	1	0	5	4	0	24.6	52.5	37.7	4.8	0	2.7
30-79	YCA 54 2277	0	1	1	1	2						
63-79	AYH 50 0082	0	0	5	0	0	79.8	54.8	0	25	0	0
66-79	AHR 50 0339	0	0	19	0	0	117.3	43.1	0	64.2	69.9	10

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	NO. BOXES REMOVED	NO. BOXES MOD'ED	NO. UNITS INSTALL.	NO. UNITS REMOVED	NO. UNITS MOD'ED	WT. TOTAL INSTALL.	WT. UNITS INSTALL.	WT. UNITS REMOVED	WT. HARDWARE INSTALL.	WT. HARDWARE REMOVED	WT. CABLES INSTALL.
102-79	YCA 54 2479	0	1	0	0	1	0	0	0	0	0	0
104-79	YCA 54 2693	0	1	0	0	1	0	0	0	0	0	0
104-79	YCA 56 0749	0	1	0	0	5	0	0	0	0	0	0
104-79	APB 50 0405	1	0	10	6	0	254.5	120.1	29.2	17.4	15	117
104-79	APB 50 0406	0	1	0	0	5	1320	0	0	1320	0	0
104-79	APB 50 0402	0	1	1	0	0	13	8	0	0	0	5
104-79	APB 50 0388	2	0	11	8	0	761.5	758	551	3.5	5	0
13-80	AAF 50 0421	0	0	3	1	0	44.2	39.8	4.2	4.4	0	0
15-80	YCA 54 2427	0	1	0	0	3	0	0	0	0	0	0
15-80	QAF 50 0410	1	0	3	3	0	61	61	56	0	0	0
18-80	YCA 54 2548	0	1	0	0	3	0	0	0	0	0	0
18-80	YCA 54 2751	0	1	0	0	1	0	0	0	0	0	0
19-81	YCA 54 2523	0	2	0	0	18						
47-81	YCA 54 2562/3	0	1	0	0	1	0	0	0	0	0	0
47-81	APB 50 0408	1	0	12	14	0	311.4	141.1	180.6	84.1	34.5	84.2
47-81	APB 50 0414	1	0	5	5	0	138.1	98.1	91.2	7.9	3.9	32.1
100-81	AAB 50 0500	1	0	5	18	0	197	131	677	46	40	20
100-81	AAB 50 0501	2	0	24	11	0	172.9	160.9	121.3	0	21.5	12
21-82	AHR 50 0345	1	0	3	2	0	45	38	45	7	5	0
31-82	APB 50 0427	0	1	5	4	0	52.5	37.3	11.6	4.1	0.9	11.1
49-82	AEB 50 0303	0	1	10	8	0	290.7	273.8	150.1	8	8.9	8
51-82	YCA 54 2588	0	1	0	0	3						
60-82	AFP 50 0660	2	0	14	9	5	44	40	78	3	1	1
62-82	AFW 50 0670	1	0	3	2	1	119	116	68	0	0	3
62-82	YCA 54 2564/65/66	0	1	0	0	2						
62-82	AFW 50 0668	0	0	2	0	1						
62-82	VFU 50 0671	1	0	5	2	0						
71-82	APB 50 0424	1	0	6	5	1	117.5	103.7	94.8	13.8	32.7	0
78-82	YCA 54 2597	0	1	0	0	1						
89-82	AAB 50 0551	0	1	2	2	0	3	3	3	0	0	0
90-82	YCA 54 2596	0	1	0	0	2						
108-82	ATJ 50 0628	1	0									
130-82	AAC 50 0636	0	1	1	1	0						
6-83	AAC 50 0602	1	0	4	4	0	53.8	35.5	44.5	7	7.1	0
101-83	AHB 50 0296	0	1	1	1	0	0	0	0	0	0	0
101-83	YCA 54 2692	0	1	0	0	4	0	0	0	0	0	0
104-83	QAE 54 2691	0	1	0	0	5						
114-83	AHB 50 0297	0	1	2	2	0						
114-83	YCA 54 2658	0	1	0	0	2						
117-84	ACH 50 0291	1	0	7	5	0	42.2	35.2	33.6	7	1	0

OSIP #	TD#	WT. CABLES REMOVED	TOTAL WT. CHANGE	WIRING CHANGE O/S/M/L/R (0-4)	INTERF	FFF?	BASIC KIT WT.	BASIC KIT DIM'S.	NO. DOCUMENTS AFFECTED	TRAINER KIT WT.	TRAINER KIT DIM'S.
27-70	VCM 50 0210			0		N	50	1536	2		
7-72	AAE 50 0461	0	57	1		N	10	1728	3		
7-72	AAC 50 0555	0	-3.85	2		N	2	512	23		
7-72	AFP 50 0570	0	0	1		N	0.5	120	4		
53-72	APB 50 0401	0	-121.9	1		N	10	768	10	10	768
53-72	APB 50 0410			1		N	12	3024	11		
53-72	AFB 50 0233	0	1.9	1		N	20	6500	4		
53-72	APB 50 0404	0	73	4		N	15	3888	14	15	3888
53-72	APB 50 0326	140	-140.1	3		N	125	62208	47		
31-73	YCA 54 2345	0	0			N			3		
31-73	YCA 54 2496	0	0			N			3		
48-74	AAF 50 0405	0	2.75	1		Y	0.5	216	22		
48-74	AAF 50 0409	0	-11.5	2		N			18		
5-75	AAF 50 0350	0	-16	1	N	Y	1	64	17		
5-75	AAF 50 0382	0	-22.4	2	N	N	22	2250	34		
28-75	ACM 50 0246	0	0	1		N			3		
1-76	AAE 50 0493	0	6	1		N	6	3200	8		
1-77	YCA 54 2233	0	0	0		N	0.75	192	1		
1-77	YCA 54 2232	0	0			N	4	512	7		
1-77	AAC 50 0567	0	-50.8	3		N	90	74088	34		
10-77	AAE 50 0482	0	0	1		N	3	1152	5		
10-77	AAE 50 0454	0	-290.7	3		N	47.33333	138240	15		
8-78	AHB 50 0281	0	10.71	2		N	11	3276	9	11	3276
8-78	YCA 54 2628	0	0	0		Y	20	768	2		
8-78	AHB 50 0267	6.5	74.1	3		N	65	11520	15		
8-78	AHB 50 0267			0		N	2	216	1		
8-78	AHB 50 0283	0	0	1		N	2.5	432	6		
8-78	AHB 50 0269	0.2	-9.8	1		N	1	423.5	7	1	423.5
8-78	AHB 54 2533	0	0	0		N	0.6	391.875	6		
8-78	AHB 50 0274	0	0			N					
22-78	APB 50 0350	0	24.65	1		N	27	5184	23		
22-78	APB 50 0395	0	38.1	2		N	0.25	24192	24		
21-79	AAF 50 0483	0	23	2	N	N	75	96	23		
22-79	YCA 54 2537	0	0	0		N			1		
22-79	AAE 50 0472	0	11.3	2		N	50	10368	30		
23-79	AAF 50 0412			1		N			14		
23-79	AAF 50 0396	0	0	1		N	2	144	18		
23-79	AAF 50 0401	0	0	1		N			15		
23-79	AAF 50 0390	0	1.4	1		N	50	14400	35		
23-79	AAF 50 0389		52	4		N	1000	233280	51		
25-79	AAF 50 0387	0		1		N	2	512	14		
26-79	AAF 50 0411	0	24.6	1	Y	Y	38	7161	26		
30-79	YCA 54 2277			3		Y	10	9000	16	10	9000
63-79	AYH 50 0082	0	79.8	1	Y	N	25	5760	17		
66-79	AHR 50 0339	0	47.4	1		N	91	9943.75	10		
	[illegible]					N	15		[illegible]	[illegible]	[illegible]

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	WT. CABLES REMOVED	TOTAL WT. CHANGE	WIRING CHANGE O/S/M/L/R (0-4)	INTERF	FFF?	BASIC KIT WT.	BASIC KIT DIM'S.	NO. DOCUMENTS AFFECTED	TRAINER KIT WT.	TRAINER KIT DIM'S.
102-79	YCA 54 2479	0	0			N	4	384	4		
104-79	YCA 54 2693	0	0	0		N	1	176	1		
104-79	YCA 56 0749	0	0	0		N	200	62208	7		
104-79	APB 50 0405	43.7	166.6	3	Y	N	150		23		
104-79	APB 50 0406	0	1320	2		N	150	103680	14		
104-79	APB 50 0402	0	13	1		N	10	864	9		
104-79	APB 50 0388	0	204.5	2	Y	N	240		43		
13-80	AAF 50 0421	0	40	1		N	50	9750	52		
15-80	YCA 54 2427	0	0	3	N	N	4	792	7		
15-80	QAF 50 0410	0	5	1	N	Y	3		29		
18-80	YCA 54 2548	0	0	0		N	1	72	1		
18-80	YCA 54 2751	0	0	0		N	1.5	216	11	1.5	216
19-81	YCA 54 2523			0		N	330	497664	38		
47-81	YCA 54 2562/3	0	0	0	N	N	3.5		8		
47-81	APB 50 0408	339.6	-237	3	N	N	250	82944	21	250	82944
47-81	APB 50 0414	5.5	36.1	2	N	N	20	21600	21	20	21600
100-81	AAB 50 0500	125	-645	2		N	90	34560	15		
100-81	AAB 50 0501	98	-67.9	2		N	200	110592	14	200	110592
21-82	AHR 50 0345	0	-5.25	0	N	Y	51.3		7		
31-82	APB 50 0427	0	39.2	2		N	20	6912	19		
49-82	AEB 50 0303	3.5	-129.1	4	N	N	350	74250	12	50	46656
51-82	YCA 54 2588		0	0	N	Y	19	1792	3		
60-82	AFP 50 0660	1	-36	3	Y	N	55	9792	17		
62-82	AFW 50 0670	0	51	2		N	21	4500			
62-82	YCA 54 2564/65/66										
62-82	AFW 50 0668		11	2		N	16	4096	2		
62-82	VFU 50 0671										
71-82	APB 50 0424	0	20.3	3		N	25	8256	14	25	8256
78-82	YCA 54 2597		0	0	Y		2				
89-82	AAE 50 0551	0	0	1	N	Y	1.5	960	31		
90-82	YCA 54 2596		0	0	N	N	3	480	3	3	480
108-82	ATJ 50 0628				N						
130-82	AAC 50 0636		0			N	2	144	3		
6-83	AAC 50 0602	0	-11.1	1	N	Y	12	3528	22		
101-83	AHB 50 0296	0	0	0		N			4		
101-83	YCA 54 2692	0	0	0		N	4	1056		4	1056
104-83	QAE 54 2691		0	0	N	N	23		1		
114-83	AHB 50 0297		0		N	Y			4		
114-83	YCA 54 2658		0	0	N		10.6	1960	2	9.5	1960
117-84	ACM 50 0291	0	7.6	2	Y	N			14		

OSIP #	TD#	EST'D. INSTALL MHRS (HRS)	SPARES KIT WT.	SPARES KIT DIM'S	EST'D. INSTALL MHRS (HRS)	GFE KIT WT.	GFE KIT DIM'S	REP'T. INSTALL MHRS@100 (HRS)	EST'D. INSTALL MHRS (HRS)	EQ TYPE	EQ PURPOSE
27-70	VCM 50 0210									S	C
7-72	AAE 50 0461									P	S
7-72	AAC 50 0555	10								P	N
7-72	AFP 50 0570		0.3	120						L	Q
53-72	APB 50 0401									W	E
53-72	APB 50 0410									Q	A
53-72	AFB 50 0233									Z	Z
53-72	APB 50 0404	60				60.0	15375.0			Y,Z	H,U
53-72	APB 50 0326									S,R,Q	A,N
31-73	YCA 54 2345									W	G
31-73	YCA 54 2496									W	G
48-74	AAF 50 0405					44.6	3456.0		44	R	N
48-74	AAF 50 0409								6	R	N
5-75	AAF 50 0350									R	C
5-75	AAF 50 0382									R	C
28-75	ACM 50 0246									R	C
1-76	AAE 50 0493									L	R
1-77	YCA 54 2233		0.75	192	10					W	E
1-77	YCA 54 2232		4	512	9					Z	U
1-77	AAC 50 0567									V	Q
10-77	AAE 50 0482									R,P	N
10-77	AAE 50 0454									R,P	A,C,N
8-78	AHB 50 0281	28								K	T
8-78	YCA 54 2628									S	Q
8-78	AHB 50 0267	840	55	11520	20					S	N
8-78	AHB 50 0267	8	2	216	2					S	A
8-78	AHB 50 0283	1								L	R
8-78	AHB 50 0269	3								P	N
8-78	AHB 54 2533		0.6		12					K	T
8-78	AHB 50 0274					12.0	2652.0		2	R	C
22-78	APB 50 0350									S	C
22-78	APB 50 0395	40	0.1	4	1					S	C
21-79	AAF 50 0483									L	E
22-79	YCA 54 2537									L	E
22-79	AAE 50 0472									L	E
23-79	AAF 50 0412									Z	U
23-79	AAF 50 0396									Z	U
23-79	AAF 50 0401									Z	U
23-79	AAF 50 0390									A	S
23-79	AAF 50 0389									S	N,H
25-79	AAF 50 0387									L	E
26-79	AAF 50 0411		1	99	4	4.0	252.0			L,P	R,Q
30-79	YCA 54 2277	30	4	102.144	6					P	G
63-79	AYH 50 0082									L	E
66-79	AHR 50 0339	180								P,L	R,E
68-79	AHX 50 0277									L	R
68-79	AHX 50 0277	415								P,L	R,E

NCA AIRCRAFT/AVIONICS MODIFICATION DATA BASE

OSIP #	TD#	EST'D. INSTALL MHRS (HRS)	SPARES KIT WT.	SPARES KIT DIM'S	EST'D. INSTALL MHRS (HRS)	GFE KIT WT.	GFE KIT DIM'S	REP'T. INSTALL MHRS@100 (HRS)	EST'D. INSTALL MHRS (HRS)	EQ TYPE	EQ PURPOSE
102-79	YCA 54 2479	4	4		4					A	S
104-79	YCA 54 2693		1	176	1					W	G
104-79	YCA 56 0749									W	P
104-79	APB 50 0405									W	G
104-79	APB 50 0406									W	P
104-79	APB 50 0402					10.0	2592.0		1.5	W	G
104-79	APB 50 0388									W	G,P
13-80	AAF 50 0421									W	G
15-80	YCA 54 2427		2	792	24					P	Q
15-80	QAF 50 0410									P	Q
18-80	YCA 54 2548		1	72	8					W	W
18-80	YCA 54 2751	0.5	1.5	216	0.5					W	W
19-81	YCA 54 2523									P	G
47-81	YCA 54 2562/3									R	N
47-81	APE 50 0408	1200				80.0	1980.0		0.5	S	N
47-81	APE 50 0414									R	N
100-81	AAE 50 0500					32.2	21487.3		0.8	P	S
100-81	AAE 50 0501	120								R	C,N
21-82	AHF 50 0345									R	N
31-82	APE 50 0427	580				20.5	2802.0		1.5	S	A
49-82	AEB 50 0303					51.0	2268.0		0.5	L	Q
51-82	YCA 54 2588	1			1					P	Q
60-82	AFP 50 0660		7	864						R	C
62-82	AFW 50 0670				174					X	X,Q
62-82	YCA 54 2564/65/66									W	G
62-82	AFW 50 0668									X	Q
62-82	VFU 50 0671									X	G
71-82	APB 50 0424	300								R	C
78-82	YCA 54 2597									Z	
89-82	AAE 50 0551					1.5	960.0		2	P	N
90-82	YCA 54 2586	41	3	480	41					P	X
108-82	ATJ 50 0628									P	N
130-82	AAC 50 0636									Y	W
6-83	AAC 50 0602	6.5								R	N
101-83	AHB 50 0296									P	N
101-83	YCA 54 2692	0.2	4	1056	1					P	N
104-83	QAE 54 2691									R	C
114-83	AHB 50 0297									P	N
114-83	YCA 54 2658	4	2	845	2					P	N
117-84	ACH 50 0291									R	C

OSIP #	TD#	FOOTNOTES	CCB DESCRIPTION PARAGRAPH#
27-70	VCM 50 0210		
7-72	AAE 50 0461		
7-72	AAC 50 0555		
7-72	AFP 50 0570		
53-72	APB 50 0401	97	
53-72	APB 50 0410	97	
53-72	AFB 50 0233	97	
53-72	APB 50 0404	97	
53-72	APB 50 0326	97,99	
31-73	YCA 54 2345		
31-73	YCA 54 2496		
46-74	AAF 50 0405		
48-74	AAF 50 0409		
5-75	AAF 50 0350	2,5,7	1
5-75	AAF 50 0382	1,2,3,5	2
28-75	ACM 50 0246		
1-76	AAE 50 0483		
1-77	YCA 54 2233	98,87	
1-77	YCA 54 2232	98	
1-77	AAC 50 0567	98	
10-77	AAE 50 0482	98	
10-77	AAE 50 0454	98	
8-78	AHB 50 0281		
8-78	YCA 54 2628		
8-78	AHB 50 0267		
8-78	AHB 50 0267		
8-78	AHB 50 0283		
8-78	AHB 50 0269		
8-78	AHB 54 2533		
8-78	AHB 50 0274		
22-78	APB 50 0350	98	
22-78	APB 50 0395	88,98	
21-79	AAF 50 0483	4,5,6	3
22-79	YCA 54 2537	89	
22-79	AAB 50 0472		
23-79	AAF 50 0412		
23-79	AAF 50 0396		
23-79	AAF 50 0401		
23-79	AAF 50 0390		
23-79	AAF 50 0389		
25-79	AAF 50 0387		
26-79	AAF 50 0411	82,83,84,85	27
30-79	YCA 54 2277	90,91	
63-79	AYH 50 0082	8,9	4
66-79	AHB 50 0339	92,93	

OSIP #	TD#	FOOTNOTES	CCB DESCRIPTION PARAGRAPH#
102-79	YCA 54 2479		
104-79	YCA 54 2693		
104-79	YCA 56 0749	94	
104-79	APB 50 0405	79,75,78,73,80	25
104-79	A'B 50 0406		
104-79	APB 50 0402		
104-79	APB 50 0388	73,74,75,76,77,78	24
13-80	AAF 50 0421	98	
15-80	YCA 54 2427	12,14,17,18,19	6
15-80	QAF 50 0410	12,13,14,15,16,17	6
18-80	YCA 54 2548		
18-80	YCA 54 2751	98	
19-81	YCA 54 2523		
47-81	YCA 54 2562/3	24,27,28	8
47-81	APB 50 0408	20,21,22,23	7
47-81	APB 50 0414	20,24,25,23,26,27	8
100-81	AAB 50 0500	95	
100-81	AAB 50 0501		
21-82	AHR 50 0345	34,35,36	10
31-82	APB 50 0427		
49-82	AEB 50 0303	64,65,66	22
51-82	YCA 54 2588	37,38,39,40	11
60-82	AFP 50 0660	67,68,69,70,71,72	23
62-82	AFW 50 0670	96,103,105,104	14
62-82	YCA 54 2564/65/66	100,101,102	12
62-82	AFW 50 0668	103,104	13
62-82	VFU 50 0671		
71-82	APB 50 0424		
78-82	YCA 54 2597	81	26
89-82	AAB 50 0551	42,43	15
90-82	YCA 54 2596	44,45,46	16
108-82	ATJ 50 0628	29,30,31,32,33	9
130-82	AAC 50 0636		
6-83	AAC 50 0602	63	21
101-83	AHB 50 0296	98	
101-83	YCA 54 2692	98	
104-83	QAE 54 2691	47,48	17
114-83	AHB 50 0297	51,56,57,58,49	19
114-83	YCA 54 2658	49,50,51,52,53,54,55	18
117-84	ACM 50 0291	59,60,61,62	20

FOOTNOTES

1. Kit weight excludes one-time issue of tool kit (6 lbs.).

2. CCB shows NRE, GSE, Pubs, and Trainer costs funded under production incorporation.

3. Not considered a FFF replacement because replacement of ARR-69 with ACR-159 adds transmit capability.

4. CCB data shows that non-recurring costs were embedded in the "AFC kits" cost element reflected in the OSIP data.

5. Non-recurring breakout obtained by allocating OSIP actuals using CCB budget data. Publications were allocated separately.

6. Pods funded under ECM common equipment line.

7. Average of aircraft parameters for the models affected shown.

8. OV-10A aircraft parameters shown.

9. A1 kit is for OV-10A, A2 kit is for OV-10D.

10. Mod program covered installation of AN/APR-39 and AN/ALE-39 for 183 A/C, 54 of which already had AN/ALE-29 installed. Installation hours for only those mods where AN/ALE-29 was not already installed are reflected here. The N/R costs for the program were allocated between the AFC and AVC proportionally with the installation hours at 100. The AFC kit costs reflect only the installation kits, as the removal and rework kits were purchased later in the program. Budgeted trainer kit amounts summed to actuals reflected in OSIP. Trainer kit cost breakout by kit type obtained form CCB budget backup.

11. Reflects installation manhours and kit weight for AN/ALE-29 removal and rework kits which affected the 54 of 183 aircraft modified in the program which already had AN/ALE-29 installed. The N/R OSIP costs were attributed to the retrofit of the AN/ALE-39 and AN/APR-39 system and are not reflected here. The AN/ALE-29 was removed from the aircraft and reinstalled as part of a new AN/ALE-39(V) system.

12. Breakout of non-recurring costs obtained from CCB budget data. CCB costs were for both the AFC and AVC performed in this modification. Half of the non-recurring costs were attributed to the AFC, and half to the AVC, as each were of similar installation complexity.

13. Kit costs shown in OSIP are for AFC only. The AVC kits were procured with the GFE, as shown in the FY82 CCB budget submission.

14. Hardware (GFE) costs includes costs of AVC kits. Component costs and AVC kit costs were indistinguishable.

15. The Digital Scan Converter Group (which is composed of a radar set control, intra target indicator, and signal data converter) was counted as one black-box.

16. Weight removed differed with aircraft configuration. An average was used.

17. Used aircraft parameters for the model which was more extensively affected.

18. Assumed AVC accomplished by contractor FMT as OSIP accounts only for contractor installations. However, the Technical Directive and TDSA show

FOOTNOTES

that the AVCs were to be performed at the Depot.

19. The costs of hardware to be modified by the AVC is not distinguishable from the total GFE costs.

20. Non-recurring cost allocation derived form CCB budget breakout. CCB-level NRE and Technical Directive budgeted amounts in CCB summed to OSIP actuals. Publications actuals were allocated to TD-level based on CCB estimates. Navy test cost identified in OSIP data was identified to AFC 408 through the CCB budget data, and the budgeted amount matched the actual cost.

21. LTN-72 unit hardware cost represents two LTN-72 systems, as there are two installations per aircraft.

22. The LTN-72 A1 and A2 kits are for different configurations of aircraft and have different kit costs, reported installation manhours, and weight of hardware added. Averages of the two values were used.

23. Spares costs were not readily allocable to specific installations based upon the data available.

24. Non-recurring cost breakout based on CCB budget for LTN-211 AFC and AVC. The Non-recurring costs were allocated between the AFC (414) and AVCs (2562/3) proportionally with the installation manhours at unit 100 (used manhours for AVC E1 kit, as no installations of AVC A1 kit reported, and estimated manhours for the E1 and A1 kits were the same.)

25. Trainer kit costs identified to LTN-211 WST and OFT through CCB budget data. Budgeted amounts summed to actuals for trainer kit costs.

26. CCB budget data identified 38.1$84K for Prototype Kit and 33.9$84K for Prototype Installation that were included in Non-recurring line in the OSIP data. The prototype costs were removed from non-recurring, here.

27. The AFC (414) and AVC (2562/3) kit costs, budgeted together in OSIP, were obtained by applying kit cost proportions from purchase request to OSIP actuals.

28. AVCs 2562 and 2563 are similar, and one or the other is performed concurrently with the AFC 414 modification. The kit weight, installation mhrs, and number of units mod'ed reflect one AVC, the number of kits reflects both.

29. Drawings was only non-recurring cost element under the OSIP. It is assumed that the other non-recurring costs occurred during the seven installations that were performed under a previous effort.

30. Cost listed as "kit" in OSIP data is actually mostly hardware, with some minor kit elements included. Components of "kit" listed in CCB are: R/T, Scope, Antenna, Radar, RT Mount, Indicator Mount, Connector Kit, Waveguide Press. Kit, and Waveguide. Costs specific to kit could not be identified.

31. Weights installed/removed not itemized in technical directive. However, it is noted that there is a positive net weight change.

32. Unable to discern from modification description whether it is a form-fit-function (FFF) replacement.

FOOTNOTES

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33. Used aircraft parameters for the T-39D (CT-39E/G parameters not available.)

34. No major kit involved in the modification. Mounting adapters are only kit cost mentioned (in OSIP description). Any minor kit costs are included in the hardware cost.

35. Used aircraft parameters for only model with available data, the CH-46.

36. Only kit weight available is for the "P1" kit (hardware) of 51.3#s.

37. TDSA reflects that two other Technical Directives were associated with this modification program. One of these appears to be a typographical error, and the other began after the period for which historical cost data is available. Therefore, historical costs were attributed to this technical directive number.

38. Non-recurring cost breakout obtained from CCB budget data. The budgeted amounts add to the total actual non-recurring cost reflected in the OSIP.

39. The two kits, A1 and A2, are for different configurations of the component (AS-2604, AS-2604B) to be modified. THe kit data and installation manhours reflect the modification of the AS-2604, as the majority of the aircraft to be modified had this configuration.

40. There was no weight change as a result of the modification, as the modification was accomlished by direct replacement of cards.

41. Interface affected by modification is that aircraft are required to to revise MGFEL to indicate new component nomenclature when modified.

42. There are two AVCs associated with this modification that are not reflected here. The AVCs were implemented to correct problems that occurred as a result of the AFCs. However, the AVCs began after the historical cost data available, so the AVCs are not accounted for here. The AVCs were intended to correct erroneous radar altimeter readouts and tendency of the radar altimeter indicator to register a zero altitude.

43. The modification was performed under AFC 431 for the first two years of the program, when installations were made into A-7E/C aircraft. The AFC number became 551 in the third year of the program, when installation began into A-6 aircraft. Since there appeared to be no significant non-recurring costs or GFE differences in the A-6 installations, it was treated as a continuation of the previous AFC. Installations into other models of aircraft began after the latest available historical cost data.

44. There were 335 installation previously completed for F-4/F-14 aircraft.

45. Installations accomplished by exchanging WRAs at the organizational level. WRAs are modified at the NARF.

46. Non-recurring costs broken out by CCB budget data. Non-recurring budgeted cost elements add to actual OSIP cost, excluding the publications costs.

... CCB budget data. Non-recurring budgeted cost

FOOTNOTES

elements nearly add to actual OSIP cost.

48. Modification affects various aircraft. Installation manhours available for one model only. Modification will standardize the RT-743. R/T is inspected to see if parts have been modified- required kits (A2-A6) are then ordered, as needed.

49. The OSIP reflects costs for both the AVC and AFC resulting from this modification. CCB data showed that the non-recurring and publications costs in the second year of the program were for the H-2 AFC requirements. The AFC and AVC have been separated into two separate data points.

50. Kits for the H-46 apparently involved the exchange of only one component, versus two for the other models. Therefore, the H-46 kit costs were not included in obtaining the average kit cost used here.

51. Non-recurring cost breakout was obtained from CCB budget data. CCB budgeted elements totalled OSIP actual non-recurring totals.

52. Different kits (A1,A2,A3) were used depending on the configuration of the receiver/transmitter to be modified. It was assumed that only one kit applied per aircraft, so an average of the kit installation manhours and kit weights was used.

53. An average of the spares B1 and B2 kit installation manhours was used. An average of the trainer E1 and E2 kit installation manhours was used.

54. Installation planned at the intermediate level, no installation costs reflected in OSIP.

55. Trainer kit costs differentiated by CCB budget data.

56. There are not kit costs associated with this AFC.

57. Assumed the AFC is form fit function because it is the replacement of the modified AN/APN-182.

58. There is another AFC (for the H-3) associated with this modification program. The H-3 AFC costs do not appear in the OSIP data, so they were not accounted for here.

59. The avionics system is in full production and used in other DoD applications, including another navy model of the C-130 (the KC-130T).

60. The TDSA and OSIP imply the modification is performed by the NARF during SDLM, however the technical directive says it is to be performed by NARF FMT.

61. The OSIP cost data was broken out by different kits and hardware sets, depending upon the configuration of the aircraft. Unit costs for the KC-130R were used, as data for both hardware and kits was available. The aircraft parameters are also for the KC-130R.

62. The interface is that the change must follow AFC 279.

FOOTNOTES

63. Aircraft parameters are for the TA-4F.

64. GFE quantities obtained from CCB budget data allowed calculation of GFE unit costs.

65. Production program budgeted to fund interim support, GSE, and GSE spares costs.

66. TDSA reflected a propellor change associated with this OSIP. The CCB data reflected an avionics change associated with the OSIP. Neither seem to be accounted for in the OSIP data, so it is possible they were funded under the production program.

67. $57K of the costs included in non-recurring engineering in the OSIP was identified as non-recurring engineering for the trainer from CCB data. The amount was removed from the actual non-recurring amount reflected in the OSIP and attributed to trainer costs.

68. Non-recurring cost breakout obtained from CCB budget data. Total of budgeted non-recurring cost elements equaled OSIP non-recurring actual.

69. Publications includes cost of data preparation package.

70. Trainer type and quantity obtained from CCB data.

71. Interface is that the modification must follow AFC 647.

72. Aircraft parameters reflect F-4J.

73. Assumed the Contractor FMT mods were to install the HACLS and the factory turnaround modifications were for the component modifications.

74. Used an average of the A1 and A3 kit installation manhours. The kits appear to be for different configurations of aircraft.

75. Cost data reflects historical data obtained from FY88/89 OSIP Budget Submission.

76. Installation and cost data reflects P-3B HACLS installation only.
Non-recurring costs for the first two years of the program were shown to be attributable to this installation by the CCB data.
Kit weights, estimated manhours, and units modified includes accounting for AAC modifications.

77. The interface is that this change must follow AFC 326.

78. The installation cost average was based only on those years where both cost and quantity installed data was available in the OSIP.

79. The interface is that the modification must follow ECP P3-923.

80. The costs and installation manhours are for the P-3C HACLS installations only.

81. Interface is that required change of MGFEL to indicate new part no.

FOOTNOTES

trainer kit were clear.

83. The interface is that the change must be concurrent with other Vought ECPs.

84. Non-recurring costs identified as government were assumed to be for the hardware, and were not included here.

85. Non-recurring engineering/design/test cost breakout was obtained from CCB NRE budget and contractor's FFP agreement cost element listing obtained from CCB files.
The total of these elements was close to the OSIP NRE actual.
Publications and ILS costs were taken from the OSIP, as they did not match the CCB estimates.

86. There was an AVC associated with this OSIP which appeared to be to correct deficiencies in the integration of the kit, and therefore are not broken out or counted as a separate modification effort.

87. Basic kit weight is average of three basic kits.

88. Kit Weights Appear to be in Error.

89. Trivial modification to change two capacitors.

90. Spare Kits Weight and Dimension is Average.

91. Spare Kit parameters reflect B4 kit.

92. Applies to 151 aircraft; and additional 110 have ALE-29 removed, modified to ALE-39 with A2 kit, and reinstalled (1 box = 8 units).

93. Average Weights and Dimensions are calculated for A1 Kits.

94. Kit weight based on A1 kits only- appears kits A2-A5 are for various configurations.

95. GFE Kit Weight and Dimensions are total of all P kits (which include components to be installed).

96. TVS Installation Replacement is used as Typical Case.

97. Installation costs were estimated in the following manner: Actual installation cost for those parts of the OSIP program performed at the NARF are known. Actual reported manhours (and estimated manhjours at Q=100) are known for each of the "A" kits planned for installation at the depot level. The reported aggregate NARF installation cost was then allocated to the particular technical directive based on estimated manhours at Q=100.

98. Installation costs were estimated by allocating the known cost of the aggregate installation (from the OSIPs) to the Technical Directives using the estimated cumulative average installation manhours at unit 100 (from TDSA).

99. Technical Directive lists combined weight for wiring/racks. Half was allocated to hardware weight, and half to wiring weight.

100. Major engineering, publications, etc. funding occurred under production program.

FOOTNOTES
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101. The AN/AWG was modified by Hughes, and funded as GFE.

102. The technical data was derived from the CCB description. Technical Directive not available.

103. Non-recurring cost elements from CCB data only totalled 76% of the Non-recurring reflected in the OSIP data, so a breakout was not attempted. It is suspected that some of the costs originally planned to be funded under the production program were shifted to the retrofit program.

104. It appears the AFC kit costs are for both the CTVS installation and also the TCS and AVTR installations. The actual AFC kit costs were allocated to the separate installations based on the estimated kit costs from TDSA. The installation cost was allocated to the installations based on the reported manhours from TDSA.

105. CCB also addressed AVC 671, but this was for trainer costs which are not reflected here.

CHANGE CONTROL BOARD PROGRAM DESCRIPTIONS

1. CCB 761-191 deals with the portion of the OSIP dedicated to installing the improved UHF Radio Set into the A-7A and A-7B. Replacement of the AN/ARC-51 with the AN/ARC-159(V)5 in the A-7A/B will increase the number of channels from 3500 to 7000, require less operating power, require less space, increase the MTBF from 50 hours for the ARC-51 to greater than 500 hours for the ARC-159. Weight reduction will be approximately 23 pounds. This is an operational improvement change.

2. CCB 751-506 deals with the portion of the OSIP dedicated to replacement of the AN/ARC-51 and AN/ARR-69 with dual AN/ARC-159 radios in the A-7E aircraft. New production A-7E aircraft received the dual AN/ARC-159 installation under the first issue of this CCB.

3. CCB 791-340 provides for the installation of the chaff dispensers. With the exception of the Aero 1D 300 gallon drop tank and the ALQ-99 Tactical Jamming Pod, the EA-6B did not have an ordnance carriage capability. This limited both training and operational employment of the aircraft. This change allows for carriage of the ALE-41 Bulk Chaff Dispenser on the five pod stations. Therefore, training and operational constraints are relieved and mission capability is significantly enhanced. The change was to be incorporated in 7 production aircraft by GAC. A total of 52 retrofit kits were required for installation by the depot level of repair. This is a product improvement change.

4. CCB 871-236 addresses the operational requirement for a countermeasures dispensing subsystem installed in the OV-10A/C to provide added protection for the aircraft operating in a hostile environment. (This ECP is an expansion of the original submitted by Rockwell International as OV-10D-16R1 approved by ACCB 801-44, AFC 82.) This is an operational improvement change.

5. CCB 881-69 fulfills the operational requirement for the chaff flare Auto Radar Warning/Dispensing System. The AN/ALE-39 Countermeasures Dispensing Set interfaced with the AN/APR-39 Radar Signal Detecting Set greatly enhances the non-vulnerability of the CH-53A/D aircraft operating in a missile environment. This is a survivability and vulnerability change.

6. CCB 781-330 funds the retrofit installation of the enhanced digital scan converter group (EDSCG). GFE EDSCG are required, consisting of: 1 ea- Signal Data Converter, Intra Target Data Indicator, Power Supply Programmer Kit, Antenna/Receiver Kit, and Control Kit Set. This is an operational improvement.

7. CCB 811-201 covers the installation of the dual LTN-72 Inertial Navigation Sets in lieu of dual AN/ASN-84 in delivered P-3C aircraft. The LTN-72 is a more reliable, all-weather, easy-

to-maintain, worldwide navigation system that is independent of ground based navigational aids. This is a reliability and maintainability change.

8. CCB 811-264 provides for the replacement of the (GFE) ARN-81 Loran with the (GFE) LTN-211 OMEGA Navigation System in delivered P-3C Non-Update Aircraft. The worldwide system of LORAN "A" has been decommissioned, thus rendering all such receivers obsolete. The ARN-81 LORAN in the P-3C is capable of receiving both LORAN "A" and LORAN "C" signals but LORAN "C" is intended for coastal navigation and is not considered long range. Consequently, the non-updated P-3C finds itself deficient in long range radio navigational capability.

The LTN-211 is a commercial, stand alone, worldwide, all-weather navigation aid built to ARINC 599 standards. This system provides automatic synchronization and continuously supplies accurate position, navigation and guidance data necessary for long range navigation. The commercial reliability design is to 1500 hours MTBF and performance accuracy is expected to be less than 2 NM. The LTN-211 is currently being utilized by the A-3 aircraft. P-3C Update and P-3A/B NAV/MOD aircraft are equipped with the ARN-99 OMEGA system which is not stand alone and therefore is not suitable for the P-3C Non-Update. This is an operational requirement change.

9. CCB 821-176 funds the installation of the CT-39 Primus 400 Radar. The installations preclude excessive mission aborts and aircraft downtime because current commercial system support is being eliminated. This is a reliability and maintainability change.

10. CCB 821-55 funds the installation of the AN/ARN-118 TACAN. The AN/ARN-52 MFHBF rate in the H-46 is 29.6 hours. The AN/ARN-118 MFHBF is greater than 1000 hours as demonstrated in similar applications (CG-53E and AH-1). In addition, the AN/ARN-118 incorporates Go/No-Go Test for Pre/In-Flight Checkout and Built-In-Test (BIT) capability for isolating faults to the plug-in modular level. These features are not available in the AN/ARN-52 equipment. This is a reliability and maintainability change.

11. CCB 812-60 funds the Search, Terrain Clearance and AFC Modules for the APQ-156 radar. The Terrain Clearance module improvement will provide at least a 3 to 1 improvement in reliability and a reduction from 60 to 10 adjustments per failure. Grumman companion ECP-872R1 provides for airframe/vehicle impact. This is a reliability and maintainability improvement.

12. CCB 822-19 provides for the AN/AXX-1 Television Camera Set Interface portion of the OSIP. This ECP proposes hardware modifications to the AN/AWG-9 System (WRA 481501 and 481580) to provide compatibility with TCS. The 481501 Sensor Control Panel WRA will be modified to delete IR, TV and Mission Data Recorder

panel interface functions from present panel interface and replace with TCS and Airborne Video Tape Recorder (AVTR) controls. The 481580 Tactical Information Display (TID) will be modified to 1) present tactical data to the pilot while the TV is being displayed on TID and 2) to reduce noise and provide compatibility with the TCS video. This is an operational improvement change.

13. CCB 791-260 provides for the Installation Provisions for the Sensor (CTVS), AN/AXQ-16(V). The basic ECP provides electrical provisions for the installation of the KB-26B Gun Camera in production A/C A405 and subsequent. Subsequently, a revision to ECP 995 was requested to provide incorporation of additional (to the KB-26B Gun Camera installation) wiring and mounting provisions for the installation of a Cockpit Television Sensor (CTVS) System in the F-14 aircraft. This is an operational improvement change.

14. CCB 821-44 provides for the Television Camera Set (TCS) System and Airborne Video Tape Recorder (AVTR). The TCS is an electro-optical system that provides the F-14A flight crew with the ability to detect, identify, and track airborne or ground targets at long standoff ranges during daylight conditions. The AVTR provides a recording of the TCS video display and crew ICS audio. Targets are displayed as high-quality, magnified television images in the front cockpit on the Vertical Display Indicator (VDI) and in the aft cockpit on the Tactical Information Display (TID) and/or the Digital Display "DD" (when deployed). This is an operational improvement change.

15. CCB 841-42 funds the incorporation of the microstrip antennas into several models of aircraft. A potential safety-of-flight situation presently exists in A-6 aircraft when the solid-state RT-1042A/APN-194 Radar Altimeter is installed. The altimeter then has a tendency to show a false lock-up at 10 feet. Although the solid-state unit will eventually be modified to correct this condition, using the already developed and tested microstrip AS-2741/APN-194 antenna will provide a short term solution, because of its superior isolation characteristics. The new antenna is directly interchangeable with the present antenna and can be installed using the same mounting holes. This is an operational improvement change.

16. CCB 822-78 funds the AN/APX-76 and RT-988/A Reliability Centered Maintenance Improvement Plan. Units which underwent TCM rework showed a MFHBF improvement which placed the equipment reliability near to its inherent MTBF. The AN/APX-76 is ranked on the Common Equipment RISE. FY 79 and subsequent have the change incorporated in production.

17. CCB 832-88 funds the R&M Improvements to the RT 743B/ARC-51A. The ECP improves the ARC-51A operational readiness, reliability, and reduces system support costs. The ARC-51A will be modified over a five year period affecting 1099 radio sets.

The ARC-51A is an out-of-production radio. These improvements have been demonstrated on the 220 units under the DRAP. The reliability has been improved from 60 MFHBF to 160 MFHBF. Retrofit will be accomplished by a rotable pool. The change will eliminate the need to incorporate any outstanding AVCs.

18. CCB 832-37 funds the AVC portion of the OSIP, the R&M improvement to the AN/APN-182. The AN/APN-182(V) Navigation Set is the ground speed and hover sensor for H-2, H-3 and H-46 helicopters. Vacuum tubes are used in the power supply module and a Klystron tube is used in the transmitter. Klystron and power supply tubes are life limited (500 hours) and expensive ($1000). Maintenance adjustments are required as the klystron ages. This change will replace the klystron with a solid state device and will use a solid state low voltage power supply module. It is expected that reliability will increase by a factor of 2 from 65 MFHBF to 150 MFHBF and that maintenance requirements will be reduced. This change can be made to the set while installed in the aircraft. Support equipment is not affected. Ship installations are not affected. This change was approved for production incorporation by ACCB 822-84 on 14 April 1982. This is a reliability and maintainability change.

19. CCB 841-266 funds the AFC portion of the OSIP. In order to install the AVC portion of the OSIP into H-2 aircraft, a companion H-2 Airframe Change was needed. Associated drawings, and initial technical manual updates were accomplished by Teledyne Ryan ECP 588-1-080-R1 and approved for production incorporation. Additional publication costs are to revise BuNo effectivity to include retrofit SH-2F inventory. This is a reliability and maintainability change. No hardware change is involved.

20. CCB 841-373 funds the C-130 Aircraft Avionic Systems Improvement Program (ASIP). The ASIP installs the DF-206 Automatic Direction Finder (ADF) to replace the AN/ARN-6 and the AN/ARN-83 in C/KC-130 aircraft; installs the AN/ARN-118 and AN/ARN-139 TACANs to replace the AN/ARN-21 and AN/ARN-84(V) in C/KC-130 aircraft; installs the VHF dual COMM/NAV system consisting of the AN/ARC-186 Transceiver and The AN/ARN-126 Receiver, to replace Radio Sets AN/ARC-73, AN/ARC-84, AN/ARC-131, AN/ARN-14, AN/ARN-18, AN/ARN-32, AN/ARN-67, and the 51z-4; installs provisions in the remainder of the KC-130 aircraft for the AN/UYQ-3A airborne Direct Air Support Center (DASC). The systems are in full production and used in other DOD applications, including another Navy model of the C-130 (the KC-130T). This is a reliability and maintainability change.

21. CCB 781-162 funds the installation of the AN/ARN-118 TACAN into the TA-4F/J aircraft. It is a reliability change.

22. CCB 801-45 funds the incorporation of PDS level 1 improvements. Costs reflected here do not include CCB 822-124 (AN/AYK-14(V) Wing Handle Correction on XN-1 Chassis), also under this

OSIP. This is an operational improvement change.

23. CCB 821-250 funds the installation of the ARC-159 radios into the F-4S. The GFE (from Collins) for the basic equipment consists of the following: switching assembly (1), receiver-transmitters (2), radio set control (4), frequency channel indicator (1), TSEC/KY-28 control (1), mounting base (1), mounting base (2). It is a reliability and maintainability change.

24. CCB 791-259 funds the kits and installations needed to retrofit the HARPOON capability into the P-3B aircraft. This change is an urgent operational improvement.

25. CCB 811-139 funds the kits and installation necessary for the GFE AN/AWG-19B(V) HACLCS including the SM-769/AWG-19B(V) HMS in the Pre-Update P-3C aircraft. The HACLCS will provide HARPOON missile capability for the aircraft. ECPs P3-846 and P3-902R1 provided for production incorporation. The HMS is needed to maintain crew proficiency without expending an operational weapon and to provide training for abnormal HARPOON missile conditions. GFE provided by ESA-20723B Procurement Request to McDonnell Douglas Astronautics Co. ECP 923S1 provides the Harpoon capable pylons.

26. CCB 822-90 funds the angle of attack reliability improvement program. An AERMIP was conducted to improve the reliability and maintainability of the SLZ-9028G indicator. A reliability improvement was successfully demonstrated which improved the indicator's MTBF from 112 hours to (500-1000) hours. The modifications consist of replacing the electromechanical (relay) motor drive control assembly with solid state circuitry and replacing wear-out components (motor, follow-up potentiometer, off-flag and switches) with newer components. This is a reliability improvement change.

27. CCB 791-241 funds the A-7E electronics warfare improvements. Vought submitted the ECP to retrofit A-7E aircraft with airframe provisions to accommodate the installation of the improved AN/ARL-45F, AN/APR-43 and AN/ALW-26B systems. The AN/APR-43 is procured as GFE via a separate ACCB action. This is an operational improvement change. Costs here do not reflect funds under ECPs which dealt with problems arising after design of the kit. CCB 842-161 corrected problems with subject mount identified during verification testing. The ECP orders cutting a notch in a corner of the shock tray to eliminate interference with other equipment. ECP 842-75 incorporates new look-through timing to make installed system operable with onboard ALQ-162.

APPENDIX C

WIRING CHANGE COMPLEXITY CLASSIFICATIONS

AVIONICS CHANGE (AVC)
WIRING CHANGE COMPLEXITY CLASSIFICATIONS

0. None.

1. Small scale modification consisting of simple part or parts replacement, change of wire or connector, label change or similar activity. Can be accomplished in 10 hours or less.

2. Medium scale modification consisting of addition, removal or replacement of several electronic parts, wires or cable harness, Reliability & Maintainability (R&M) improvements or replacement of tube-type with solid-state components. May require from 10 to 75 hours to accomplish.

3. Large scale modification consisting of replacement of parts, circuit boards, wiring and cable harnesses that materially enhances capability of the system. Completed modification will require extensive testing before returning to service. Will require 75 to 200 hours to accomplish.

4. Major equipment modification in which extensive wiring or modifications are made to complex equipment (such as detection systems, computers, etc.) or black-box modifications involving over 50 percent of the functional components. May require replacement of large numbers of circuit components, wire, connectors, cable harnesses. Substitution of printed circuit boards or shop replaceable units may accompany the modification. Extensive testing and checkout will be required, and the modification will in all probability be accompanied by extensive changes to support equipment and training equipment. The modification and testing will require over 200 hours.

AIRFRAME CHANGE (AFC)
WIRING CHANGE COMPLEXITY CLASSIFICATIONS

0. None.

1. Small scale changes to electrical or signal wiring or connectors to accommodate new equipment or removals of some existing wiring that is no longer required.

2. Medium scale cabling changes involving replacement of one or more cabling harnesses or interconnection between several new or existing units.

3. Large scale wiring changes such as interconnection of numerous electronic systems to accommodate a new central computer, integration of all aircraft weapons into new central weapon control system, or wing wiring of pylons to weapon control system to handle missile systems.

4. Major rewiring of the aircraft such as removal and replacement of all aircraft or wing wiring or installation of a data bus in lieu of standard wiring.

APPENDIX D

INSTALLATION MANHOUR DATA USED FOR LEARNING CURVE CALCULATIONS

lection Criteria for Sample to Calculate Average Learning Curve

	TD#	TITLE	Q2	CAC2	L. CURVE	ACTION	REASON
	VCM500210	E1 MODE 1 CAPACITOR BANK INSUL STRIP ARC PVNT	4	13.00	70.71%		
	AAC500555	A1 APN-194/141 RADAR ALTM SYS.INTCHG INSTL OF	46	11.33	58.37%	delete	under 60%
	AAC500555 1	A2 APN-194/141 RADAR ALTM SYS.INTCHG INSTL OF	59	11.19	65.58%		
	AAE500398	00 APN-194/APN-141 STOWAGE CONNECTOR/JUMPER	146	0.18	99.33%	delete	admin mod
	AAE500398	A1 APN-194/APN-141 STOWAGE CONNECTOR/JUMPER	119	12.24	99.83%		
	AAE500406	A1 AN/APN-194(V),PROVISIONS FOR	78	67.08	87.86%	delete	armor plate installation (see td)
	AAE500424	A1 AN/APN194 RADAR ALTIMETER, PROVISIONS FOR	79	13.92	114.66%		
	AAE500461	A1 RADAR ALTIMETER, MOD OF	4	37.00	50.00%	delete	under 60%, bad data
	AFP500570	A1 ELECTRONIC ALTIMETER,AN/APN-194,INSTL OF	206	19.26	88.77%	delete	same as A2 kit, diff nosecap
	AFP500570	A2 ELECTRONIC ALTIMETER,AN/APN-194,INSTL OF	313	19.45	87.09%		
	AFP500570 1	00 ELECTRONIC ALTIMETER,AN/APN-194,INSTL OF	497	1.14	153.71%	delete	admin mod
	APB500300	A1 RADAR NAV SYS;PROV FOR APN-194V ELEC ALTM SET	96	10.32	50.00%	delete	under 60%, bad data
	APB500354	A1 AN/APN194V, INSTL OF	249	30.61	81.59%		
	ATL500096	00 AN/APN-194 RADAR ALTIMETER,INC OF	40	0.05	50.00%	combine	parts of mod, bad data
	ATL500096	01 AN/APN-194 RADAR ALTIMETER.INC OF	37	123.43	95.33%	combine	parts of mod
	ATL500096	02 AN/APN-194 RADAR ALTIMETER,INC OF	37	89.54	96.38%	combin	parts of mod
	APB500233	01 FUEL PUMP SCAVENGER INLET SCREEN ADDITION	316	5.20	106.56%	delete	non-avionics mod
	APB500326	A1 IMPROVED TACTICAL NAV SYS, INSTL OF	27	844.44	100.48%		
	APB500326	03A3 INSTL OF IMPROVED TACTICAL/NAVIGATION SYS	15	406.47	102.52%	delete	must be for diff. A/C config, A3 kit
	APB500401	A1 MARINE HERKER RETRO LAUNCHER SYS REMOVAL	167	15.63	70.83%		
	APB500404	A1 RD-461 DIG TAPE RECORDER,INSTL OF	163	43.77	80.29%		
	APB500410	A1 DICASS PROVISIONS INSTALLED	161	121.31	81.28%		
	APB500410	0200 DICASS PROVISIONS INSTALLED	162	4.00	70.33%	delete	admin mod
	AAF500325	A1 AN/ARN-84 V TACAN, ALTERNATE INSTL OF	264	17.54	75.29%		
	AAF500325 1	00 AN/ARN-84 V TACAN, ALTERNATE INSTL OF	238	0.25	115.29%	delete	admin mod
	AAF500405	A1 AN/ARN-84 V TACAN, ALTERNATE INSTL OF	58	8.28	104.61%		
	AAF500409	00 AN/ARN-118(V) TACAN,INSTL OF	86	8.13	99.42%		no kit shown in TD
	AAE500462	A1 AVIONICS COMMUNICATION NAV IDENT UPDATE	64	317.25	88.44%		
	AFP500585	A1 AN/ARC-159 RADIO SET INSTL	206	68.79	89.74%		
	AAE500493	A1 RADAR WARNING RECEIVER,INSTL OF	348	6.99	69.20%		
	AAE500454	A1 AIRCRAFT MODIFICATION/UPDATE	19	1266.58	153.40%	delete	mod cancelled-amended, under 60%
	AAE500454	A2 AIRCRAFT MODIFICATION/UPDATE	12	222.75	57.46%	delete	mod cancelled-amended, under 60%
	AAE500454 A	A1 AVIONICS, BASIC AIRCRAFT REWIRE & UPDATE	23	1119.70	98.49%		parts of mod of for diff configs?
	AAE500454 A	A2 AVIONICS, BASIC AIRCRAFT REWIRE & UPDATE	23	27.13	83.87%	delete	parts of mod of for diff configs?
	AAE500454 A	A3 AVIONICS, BASIC AIRCRAFT REWIRE & UPDATE	23	1131.00	98.49%	delete	parts of mod of for diff configs?
	AAE500482	A1 ARN-84/APN-153 CONTROL PANELS,RELOC OF	23	7.83	72.58%		
	AAF500381	A1 AIR CONDITIONING TEST POINT FITTINGS,MOD OF	421	8.46	80.68%	delete	non-avionics mod
	TGA623123	A1 AN/APM-376 RADAR TEST BENCH MOD	2	14.00	175.00%	delete	supt. eq. mod, over 120%
	AEB500267	A1 AN/ASN-123 TACAN SYSTEM	97	692.79	62.18%		
	ANB500267 1	A2 AN/ASN-123 TACNAV SYSTEM INSTALLATION	97	5.03	68.30%	delete	amendment
	AEB500269	A1 RADAR RANGE IMPROVEMENT	96	5.29	99.40%		
	ANB500274	00 AN/ARC-159-1,UHF TRANSCEIVER	97	1.20	59.28%		no kit shown in TD
	AEB500281	A1 PILOT/COPILOT CHECKLIST PANEL,REPLACEMENT OF	96	1.18	79.03%	delete	TD doesn't show A1 kit
	ANB500281	02A2 DIFAR/DICASS SONOBUOY DATA LINK,INSTALLATION	97	13.89	77.79%		
	AEB500283	A1 ALR-66(V)1 MOD, PROVIDE ESM VOLUME CONTROL	97	1.59	63.08%		
1	AER500249	A1 ALQ-141 AND AQS-14 PROVISIONS	30	705.03	60.60%		
2	APB500350	A1 INSTL,INTERIM INTEGRATED ACOUSTIC COMM SYS	42	38.90	147.77%	delete	over 120%
2	APB500395	A2 INSTL OF OV-78A GENERATOR PROC GRP PROVISIONS	154	179.13	100.89%		
2	APB500395	A3 INSTL OF OV-78A GENERATOR PROC GRP PROVISIONS	34	179.47	89.08%	delete	same mod as A2-diff config.
1	AAE500473	00 AIRBORNE MOVING TARGET INDICATOR RETRO INCORP	344	3.19	73.71%		
6	AAE500487	A1 ALE-29A REPL BY ALE-39 CHAFF SYSTEM	65	216.98	58.73%		

Selection Criteria for Sample to Calculate Average Learning Curve

IP	TD#	TITLE	Q2	CAC2	L. CURVE	ACTION	REASON
019	AAE500497	A1 IMPROVED REPLACEABILITY OF A/C POD WIRING	12	218.00	86.60%		
019	YCA542505	00 AN/ALQ-99 FALSE TARGET CIRCUITRY,MOD OF	237	15.58	101.88%		
019	YCA542647	A1 AN/ALQ-99 LOW POD RADOME MOD	9	17.44	115.21%		
021	AAE500483	A1 CHAFF DISPENSER POD,INSTL OF	53	212.81	79.58%		
022	AAE500472	A1 INCORP OF DISPENSING SET	49	101.27	77.16%		
023	AAF500389	A1 MULTI MUNITIONS & FLIR WIRING	348	409.93	56.07%	delete	under 60%
023	AAF500390	A1 AN/AVQ-7 HUD INC OF FLIR CAPABILITY	348	11.13	55.55%	delete	under 60%
023	AAF500396	A1 FLIR ACFT ALTITUDE HOLD DISENGAGE WARNING SYS	54	13.54	53.66%	delete	under 60%
023	AAF500401	A1 RADAR ALTIMETER WARNING LIGHT	62	6.87	64.68%	delete	relocation of warning light
023	AAF500412	00 FLIR SYSTEM,MOD OF	49	6.08	64.48%		no kit shown in TD
025	AAF500387	00 AN/ALE-39 AUTOMATIC CHAFF DISPENSER,INSTL OF	126	0.07	50.00%	delete	admin mod, under 60%, bad data
025	AAF500387	A1 AN/ALE-39 AUTOMATIC CHAFF DISPENSER,INSTL OF	287	38.84	67.95%		
025	AAF500413	A1 AN/ALE-39 CHAFF DISPENSING SYSTEM RETROFIT	80	11.68	65.64%		
026	AAF500411	A1 ELECTRONIC WARFARE IMPROVEMENTS	212	168.11	72.94%		
026	AAF500411	A2 ELECTRONIC WARFARE IMPROVEMENTS	195	3.54	63.10%	delete	must be for diff config than A1
026	AAF500411	A3 ELECTRONIC WARFARE IMPROVEMENTS	193	113.40	80.39%	delete	must be for diff config than A1
032	AFP500632	A1 INC OF AN/ALE-39 COUNTERMEASURE DISPENING SET	30	183.73	91.37%		
063	AYE500082	A1 AN/ALE-39 INSTALLATION	62	129.18	60.15%		
066	AHR500339	A1 INSTL OF AN/ALE-39/AN/APR-39,REMOVAL AN/ALE29	274	283.05	64.53%		A1 for afc
066	AHR500339	A2 INSTL OF AN/ALE-39/AN/APR-39 REMOVAL AN/ALE39	274	28.82	98.49%		A2 for avc
068	AHE500277	A1 INSTL OF ALE-39 AND APR-39 SETS	186	123.11	82.84%		
084	APB500387	A1 TRIPLE VERNIER DIFAR/DICASS PROVISIONS,INSTL	116	70.54	50.00%	delete	don't know if double counting, under
084	APB500387	02A2 INSTALL TRIPLE VERNIER DIFAR PROVISIONS	51	2.57	85.67%	delete	don't know if double counting
084	APB500387	0400 DIFAR,DIRECTIONAL FREQ ANALYZING/RECORDING	168	7.82	68.38%	delete	don't know if double counting
084	APB500387	0500 DIFAR,DIRECTIONAL FREQ ANALYZING/RECORDING	200	8.30	94.09%	delete	don't know if double counting
084	APB500387	06A4 ASW SYSTEM,DATA PROC/CRYPTO DEVICE,REMOVAL OF	53	2.11	134.29%	delete	don't know if double counting
084	APB500387	07A5 ASW SYSTEM,ENHANCED COOLING,E1/E2 RACK,INSTL	200	48.55	82.53%	delete	don't know if double counting
084	APB500387	08A4 ASW SYSTEM,DATA PROC/CRYPTO DEVICE,REMOVAL OF	116	3.62	66.12%	delete	don't know if double counting
084	APB500443	A1 ASW SYSTEM;AN/AQA-7A(V)8-37 DIFAR SYS,MOD OF	228	5.36	115.89%		
084	YCA542656	A1 AN/AQA-7A CONTROL PANEL/BEARING COMPUTER MOD	116	10.35	123.12%	delete	over 120%
102	YCA542479	A1 C8759/ & C8759A/AA INFRARED CONTROL CONVERTER	106	3.43	133.23%	delete	over 120%
104	APB500388	A1 HARPOON MISSILE SYSTEM,INSTL OF	23	201.70	50.00%	delete	under 60%, bad data
104	APB500388	A3 HARPOON MISSILE SYSTEM,INSTL OF	30	180.33	50.19%	delete	for diff config from A1 kit, under 6
104	APB500402	A1 SM-769/AWG-198 HARPOON SIMULATOR	19	11.95	50.00%	delete	under 60%, bad data
104	APB500405	A1 HARPOON MISSILE CAPABILITY,UPDATE	147	742.36	101.73%		
104	APB500406	A1 STANDARDIZED WING PYLONS RETROFIT	146	2.50	67.30%	delete	not avionics
9104	APB500406	A2 STANDARDIZED WING PYLONS RETROFIT	45	2.44	85.37%	delete	diff config from A1 kit
9104	APB500406	A3 STANDARDIZED WING PYLONS RETROFIT	53	1.89	70.42%	delete	diff config from A1 kit
9104	APB500406	A4 STANDARDIZED WING PYLONS RETROFIT	85	0.71	72.57%	delete	diff config from A1 kit
9104	APB500406	A5 STANDARDIZED WING PYLONS RETROFIT	22	1.45	70.33%	delete	diff config from A1 kit
9104	YCA542693	A1 HARPOON INTERCONNECTING ADD CAUTION DECAL	79	1.14	171.96%	delete	not avionics, over 120%
0013	AAF500421	A1 ATE HARN,RETROFIT INC OF	409	85.33	65.24%		
0013	YGA623873	A1 AN/ASM-407 INTERFERENCE BLANKER TS MOD	3	2.33	71.17%		
0015	AAF500410	A1 DIGITAL SCAN CONVERTER GROUP,INCORPORATION OF	409	15.62	71.13%		
0018	YCA542548	A1 AN/AWW-7B TONE DECODER FILTER ADDITION	7	5.29	121.95%	delete	over 120%
0018	YCA542751	A1 WALLEYE E2588451 FREQ CONTROL MOD	2	2.00	106.25%	delete	qty went down?
0046	AEE500327	A2 LTN-211 OMEGA/VLF NAVIGATION SYS INSTL	53	57.36	82.80%		
1019	YCA542523	A1 AN/AWG-10A TECHNICAL OBSOLESCENCE PROGRAM	39	34.26	66.78%		
1025	YCA542521	A1 AN/AWG-9 COMPUTER EXPANDED MEMORY	18	3.06	162.91%	delete	over 120%
1025	YCA542522	00 AN/AUG9 DIGITAL COMPUTER MRA 481451 MOD	87	1.29	143.64%	delete	over 120%
1047	APB500408	A1 LTN-72 INS-ILO,ASN-84 RETROFIT	23	712.96	220.84%	delete	over 120%

a Selection Criteria for Sample to Calculate Average Learning Curve

IP	TDN	TITLE	Q2	CAC2	L. CURVE	ACTION	REASON
047	APB500408	A2 LTN-72 INS-ILO,ASN-84 RETROFIT	148	1144.26	89.45%	delete	diff config from A1 kit
047	APB500414	A1 LTN-211 OMEGA NAVIGATION	117	268.25	95.56%		
064	TCA542726	A1 TACANC FREQ TIME STANDARD DIGITAL DISPLAY	4	1.00	100.00%	delete	not avionics?
064	TCA542834	A1 115 VAC POWER TO AIRBORNE ENHANCED VERDIN PRO	51	3.29	144.72%	delete	not avionics?, over 120%
021	AHR500345	00 INSTALLATION OF AN/ARN-118 TACAN	113	3.57	64.23%		
031	APB500427	A1 AN/ASA-65 (V)2 MAGNETIC COMPENSATOR GRP ADP	156	377.35	86.89%		
031	APB500427	A2 AN/ASA-65 (V)2 MAGNETIC COMPENSATOR GRP ADP	156	40.46	88.23%	delete	assume for diff config?
031	APB500427	A3 AN/ASA-65 (V)2 MAGNETIC COMPENSATOR GRP ADP	95	23.37	87.49%	delete	assume for diff config?
051	TCA542588	A1 AN/APQ148/156B RADAR AUTO FREQ CONTROL	146	4.18	102.89%		
051	TCA542588	A2 AN/APQ148/156B RADAR AUTO FREQ CONTROL	6	3.17	102.11%	delete	diff config from A1 kit
051	TCA542588	B1 AN/APQ148/156B RADAR AUTO FREQ CONTROL	9	2.44	146.58%	delete	spares, over 120%
060	AFP500660	A1 ARC-159 RADIO SETS	263	50.65	62.55%		
062	AFW500668	A1 COCKPIT TELEVISION SENSOR,INSTL OF	409	126.15	57.30%	delete	under 60%
062	AFW500670	00 TCS SYSTEM/AVTR,MOD OF	415	108.92	71.45%		
062	TCA542564	A1 AN/AWG9 TV CAMERA SET INTERFACE WRA 481962	31	3.03	55.04%	delete	under 60%
066	TPA660459	00 SPH3C HELMET MOUNTING OF AN/AVS6 SYS	39	1.08	101.41%	delete	not in a/c
071	AFB500424	A1 INSTALLED KY-75 PARKHILL PROVISIONS	227	225.47	93.44%		
089	AAR500551	00 MICROSTRIP ANTENNAS INCORP	563	1.37	91.74%		
108	ATJ500628	00 CT-39 PRIMUS 400 RADAR INSTALLATION	18	116.67	50.00%	delete	under 60%, bad data
130	AAC500636	A1 MOD OF CPU-66/A ALTITUDE ENCODING COMPUTER	325	2.79	84.15%		
083	TCA560804	A1 BRU14 BOMB RACKS IN BOMB BAY	2	3.50	70.00%		

Selection Criteria for Sample to Calculate Average Learning Curve

iptions:

: data points were deleted where:
They were probably administrative modifications. Examples are OSIP 3-75, 1782 Amendment 1 corrects a typographical error in the testing ructions. In OSIP 28-75, AFC 239, Amendment 1 corrects the basic alization and adds serial numbers for FY80 funding. Amendment 2 serials for Fy81 funding. These mods usually involve low mhrs.

The data point was a kit other than the A1 kit (e.g., A2, A3) that ared to be modified for a different configuration of aircraft, to be for the same aircraft model and same modification.

The data point was not for basic equipment, but rather spares, etc. , is not for an "A" kit.

The calculated learning curve was above 120% or below 60%.

The change did not appear to involve avionics.

The modification had been cancelled, and replaced by a new TD.

The TDSA data appeared incorrect (ex., quantity installed decreased) ty increased but the total mhrs are the same.

The modification was not internal to the A/C.

It was not clear if all parts of the kit are included.

points were combined when:

Kit was in two parts. An average of the learning curves was used as data point.

s:
re deletions and combinations yield 60 data points.
s data set includes only those cases where there were reported hours in TDSA both at the 1986 and 1987 data collections, and tallations had been reported between 1986 and 1987 data collections.

APPENDIX E

NAVY AIRCRAFT MODIFICATION FUNDING AND IMPLEMENTATION CYCLE

NAVY AIRCRAFT MODIFICATION FUNDING AND IMPLEMENTATION CYCLE

It became apparent through previous and current research that no single data source offers the "whole picture" of a modification program. Therefore, several data sources were explored in an effort to obtain all available information on the modification programs under consideration. To properly evaluate the data sources, it is necessary to realize the point in the modification cycle that they reflect. Therefore, it was necessary to investigate the funding and implementation cycle for aircraft modifications.

Information on modification budgeting was obtained through interviews with NAVAIR and NAMO (Naval Air Maintenance Organization) personnel, as well as through references to <u>NAVAIR Instruction 4130.1B</u> "Naval Air Systems Command, Configuration Management Manual," 23 April 1986 and <u>NAVAIRNOTE 4000</u> "Submission of Operational, Safety, and Improvement Program Items for the Aircraft Modification Budget for Fiscal Year 1988 (Report Symbol NAVAIR 4000-10)," 3 October 1985.

Modifications to aircraft are accomplished through Engineering Change Proposals (ECPs). An engineering change is any alteration to the configuration item or item delivered, to be delivered, or under development, after formal establishment of its configuration. This study deals only with those cases where the aircraft has been delivered, and the modification is retrofit into the aircraft. In-production and out-of-production aircraft are both considered.

The NAVAIR configuration manual instructs that prior to requesting an ECP, both the requestor and the contractor or CFA (Cognizant Field Activity) should have a thorough understanding of the ramifications of the contemplated change. Contractors should be encouraged to submit letters to their local government representatives, to NAVAIR HQ PMA or the Weapon System Manager (WSM) summarizing changes they would like to propose. Conferences should be held with contractors at regular intervals to discuss problems and proposed changes. If, as a result of these letters or conferences, the feasibility of implementing a particular change is confirmed, a written request for a formal ECP will be forwarded from NAVAIR HQ PMA or WSM to the contractor via the local government representative.

Engineering changes are generally funded through an Operational Safety Improvement Program (OSIP) vehicle. An OSIP may include multiple ECPs. The Program Manager is responsible for preparing an OSIP budget submission that covers the proposed change(s) to the aircraft. The OSIP budget is reviewed by NAVAIR for adherence to budget guidelines, formatting, or obvious funding problems. The budget is returned to the PM for revision, if required. OSIP items are then included in the submission to the Chief of Naval Operations (CNO) OP-506 each year for planning, programming, and budgeting for the modification and modernization of in-service aircraft, weapon systems, and power plants. The submission is made to the CNO two fiscal years before funding is expected (e.g., OSIP submissions to receive FY88 funding were submitted to CNO at the beginning of FY86).

Modifications to production line aircraft may or may not be retrofit into aircraft in service. If this is desired, an OSIP is prepared, reviewed, and if approved, budgeted.

Not all proposed changes have the necessary scope, appeal, sense of urgency, or whatever may be required, to inspire an OSIP. These may not be acted upon until a modification comes along that does have the required appeal. This OSIP then becomes the vehicle to which the minor changes are attached as riders. OSIPs are seldom "pure", but more likely a mixture of several modifications which may hardly be related. The OSIP budget backup descriptions give prominence to the main modification and may mention the others only in passing, or maybe not at all.

When change or operational, safety, and improvement program (OSIP) requirements have been included in the Congressional budget, normally submitted in January, requests for ECPs and CCB (Change Control Board) submissions should be initiated in February so that they can be processed by 1 October, when funds become available for obligation.

There are two different categories of ECPs: solicited and unsolicited. Solicited ECPs are prepared by the cognizant AIR-05 APM (S&E) or equivalent officer responsible for design engineering. Contract permitting, requests for an ECP to contractors will include direction to submit a price proposal for the ECP. Unsolicited ECPs may originate from a contractor, any field activity or any segment of the fleet, via the appropriate chain of command. The ECP is obtained from the contractor or NARF, is sent to AIR-05, and distributed to the PM. Then, prior to a formal request for an ECP, all ramifications of the change will be considered, including funding availability in the time frame of estimated ECP approval.

Upon receipt of an ECP, the PM will contact the AIR-04 Logistics Manager for the item affected. The contact is intended to accomplish a preliminary review and evaluation of the merits of the proposal. If the ECP is acceptable, the PM will issue a decision memorandum, which will be distributed to all who must act on or prepare the ECP for CCB consideration.

AIR-05 performs a detailed engineering review to determine the total impact of the change. The ECP change request is then hand-carried to affected organizations where effects on weight and performance guarantees, service life limits, GFE, support equipment, computer programs and human factors are evaluated and noted on the request. Following all processing and review at AIR-05, the request is hand-carried to AIR-04.

The AIR-04 Logistics Manager (LM) is responsible for the cost, funding, and milestone aspects of the change. The LM is responsible for obtaining concurrence on availability of funds for the different costs affected by the ECP request.

The change is presented to the Change Control Board, which has responsibility to review the change, and is authorized to approve or disapprove Class I engineering changes. The purpose of the Board is to assure that all aspects of a proposed change have been thoroughly staffed, implementation actions identified and positive directions approved. The board consists of experienced, qualified personnel formally designated by their commanders to serve as CCB members. The following list identifies membership positions for the CCB.

Voting Members:	The Chairman (AIR-01) or Co-chairman (AIR-102).
	Assistant Commander for Systems and Engineering or specifically designated representative(s) (AIR-05 and ESA-20).
	Assistant Commander for Fleet Support and Field Activity Management or a specifically designated representative (AIR-04).
Full-Time Associate:	NAVAIRHQ Contracts Group (AIR-02) representative.
Members (non-voting):	NAVAIRHQ Support Equipment Division (AIR-552) representative.
	Aviation Training Systems representative (APC-205).
	ASO representative.
	NAVAVNLOGCEN representative.
	NAVAIRTECHSERVFAC representative.
Associate Members: (as appropriate) (non-voting)	NAVAIRHQ Safety Officer (AIR-09E)
	NAVAIRHQ computer software representative.
	NAVAIRENGCEN representative.
	SPCC representative.
	Naval Training Equipment Center representative.
	Test and evaluation representative.
	U.S. Army, Air Force or foreign government representative - when applicable.
CCB Secretariat: (non-voting)	Recorder Secretary.

Following CCB approval, the ECP is usually contracted to the prime contractor, and incorporated into the next fiscal year's buy of production aircraft. After the ECP is designed, the old and revised drawings for production aircraft become the basis for creating a Technical Directive (TD) for retrofit. No TD is required for assembly line production, only for modification of existing aircraft.

TDs, which detail the specific instructions for a change, are sent to the installing activity. TD preparation and validation are usually procured under the non-recurring cost of the OSIP. There is generally one TD per ECP. The installation may be performed by the contractor or at the Naval Air Rework Facility (NARF). Retrofit installation is generally accomplished with O&MN funding, whereas the kits are procured with APN-5 funding.

Master copies of CCB directives and copies of related implementing correspondence are retained by AIR-1022 for three years until retirement to the archive files. Official contract files are maintained at the NAVAIR HQ Communications and Files Branch (AIR-7161). CCB data is also tracked on MODPIMS (Modification Program Implementation Monitoring System). MODPIMS is an automated system designed to provide a record of modification program implementation requirements and status.

Installation information is also tracked on the Technical Directive Status Accounting (TDSA) system, maintained at the Naval Air Maintenance Organization (previously the Naval Air Logistics Center) at Patuxent River, Maryland. Installation manhours are reported from the installing activities. The frequency of reporting installations varies with installer—NARFs have on-line access to TDSA, and may report installations on a daily basis, whereas contractors may report only sporadically, depending on contract stipulations.